



National Diploma Certificate level-5, in (Construction Materials Supervisor)



Competency Standards

National Vocational and Technical Training Commission
(NAVTTTC) Government of Pakistan



Table of Contents

1. Introduction	4
2. Purpose of the Qualification	4
3. Core competencies of the Qualification	5
4. Date of Validation	7
5. Codes of Qualifications	8
6. Members of Qualifications Development Committee	8
7. Members of Qualifications Validation Committee	8
8. Entry Requirements	9
9. Scheme of Studies	9
10. A- Occupation Packaging of Construction Materials Testing	10
10. B-Qualification Packaging of Construction Materials Testing	10
11. Detail of Qualifications and its Competency Standards	12
D. National Diploma Certificate Level 5 in Construction Material Supervisor	12
11.16. Calibration	12
11.16.1 Perform Standard Calibration of pH meter	12
11.16.2 Perform Standard Calibration of Weighing Balance	14
11.16.3 Perform Standard Calibration of Pressure Gauge	17
11.17. Plant Supervision	20
11.17.1 Supervise the Operations of concrete Batching Plants	20
11.17.2 Supervise the Operations of Asphalt Concrete Plants	23
11.17.3 Supervise the Operations of Crushing Plants	26
11.18. Safety Management	28
11.18.1 Evaluate Air Pollution	28
11.18.2 Determine Noise Pollution	31
11.18.3 Manage Safety at Construction Site	33
11.19. Inspection Techniques	37
11.19.1 Conduct Geotechnical Site Investigations	37
11.19.2 Supervise sampling, inspections and field testing at construction sites	40
11.19.3 Plan & conduct the inspection of construction materials, products & processes	42
11.19.4 Assess construction faults in buildings	44
11.19.5 Develop maintenance plan for roads	47
11.20. Hydraulics Engineering	49
11.20.1 Determine Hydrostatic pressure	49
11.20.2 Apply Hydro kinematic Principles	51
11.21. Lab Management	54
11.21.1 Plan and organize the laboratory work.	54
11.21.2 Implement laboratory quality control procedures.	57
11.21.3 Analyze data and report results	60
11.21.4 Apply quality system and continuous improvement processes	63
11.22. Inspection and Testing of Concrete Structures	66
11.22.1 Perform NDT by rebound hammer and Rebar Detector tests	66
11.22.2 Perform Ultrasonic pulse velocity and Penetration Tests (Windsor Probe)	70
11.22.3 Perform NDT Pull out Test and Profometer test	74
11.22.4 Perform rebound hammer test and Rebar Detector test (NDT) for RCC Bridge	78



11.22.5	Perform Ultrasonic pulse velocity test and Penetration test by Windsor probe for concrete Bridge	82
11.22.6	Perform Pull out test and Profometer test on RCC Bridge	86
11.22.7	Perform Flat Jack Test and Impulse Radar Test	90
11.22.8	Perform Stress rupture Test and Creep Test on pipes	94
11.22.9	Perform Full Notch Creep Test and Small-scale steady-state test	98
11.22.10	Conduct Tensile Test, Compression Test and Leakage Detection Test	102
11.22.11	Conduct hydraulic pressure test and 3 edge bearing test on RCC pipes	106
11.23.	Inspection and Testing of Steel Structures	110
11.23.1	Perform Hardness Test on metals using Rockwell Method	110
11.23.2	Perform Hardness Test on metals using Brinell Method	112
11.23.3	Conduct Impact test on metals	114
11.23.4	Conduct bending test on metals	116
11.23.5	Conduct Tensile Test on Metals Using Young's Modulus Apparatus	118
11.23.6	Conduct Tensile Test on Metals Using UTM	120
11.23.7	Conduct Torsion Tests on metals	122
11.23.8	Perform Radiographic and Ultrasonic Testing on Steel Bridges	124
11.23.9	Perform Dye Penetrant Inspection or Liquid Penetrant Inspection (LPI) on Steel Bridges	126
11.23.10	Perform Magnetic Particle Inspection on Steel Bridges	128
11.23.11	Perform Eddy Current Testing on Steel Bridges	130
11.23.12	Perform Visual Inspection on Steel Bridges	132
11.24.	Entrepreneurial Skills	134
11.24.1	Investigate micro business opportunities	134
11.24.2	Develop a micro business proposal	137
11.24.3	Develop a marketing plan	139
11.24.4	Develop and review a business plan	141
11.24.5	Organize finances for the micro business	143
11.24.6	Manage human resources	145
11.24.7	Market products and services	148
11.24.8	Monitor and review business performance	151
11.24.9	Negotiate for resolving business issues	153



1. Introduction

Materials which are used for construction purposes are known as the engineering materials or building materials or construction materials. A wide range of building materials are available for the construction of rural buildings and structures. The proper selection of materials to be used in a particular building or structure can influence the Safety, original cost, maintenance, ease of cleaning, durability and, of course, appearance. Usually, construction materials are classified into natural construction material (Water, Mud, Stone, Sand, Wood, Leaves, Lime, Fiber and etc.) and artificial construction material (cement, Brick, Tiles, Glass, Metals, Plastic and etc.). It is necessary for the Civil Engineers/Civil Technologist/Lab Engineers/Lab Assistant to have knowledge about materials, properties and their standard testing methods.

Construction Materials Testing have significant role in the life of every human being, though one may not truly sense its importance in our daily routine. Thus, the importance of civil engineering may be determined according to its usefulness in our daily life. Therefore, industry expectations for skilled workforce are also dynamic which can only be managed through setting relevant competency standards in collaboration with the leading industries. Being familiar of this fact, National Vocational & Technical Training Commission (NAVTTTC) developed competency standards for Construction Material Testing Technology under National Vocational Qualifications Framework (NVQF). These competency standards have been developed by a Qualifications Development Committee (QDC) and validated by the Qualifications Validation Committee (QVC) having representation from the leading Construction, Real States & Builder industry of the country.

2. Purpose of the Qualification

The purpose of this qualification is to set high professional standards for construction Materials Testing technology sector. The specific objectives of developing these qualifications are as under:

- Improve the professional competence of the trainees
- Provide opportunities for recognition of skills attained through non-formal or informal pathways
- Improve the quality and effectiveness of training and assessment for construction Materials Testing industry
- Enable the existing workforce to capacitate themselves in new technologies and methods



3. Core competencies of the Qualification

The construction Materials Supervisor qualifications of level 5 consists 40% Theory and 60% Practical. The Core competencies of the qualification are as follows:

Construction Material Supervisor Level-5 Part-I

11.16 Calibration Techniques

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.16.1	Perform Standard Calibration of PH	5	8	18	26
11.16.2	Perform Standard Calibrations of weighing balance	5	10	33	43
11.16.3	Perform Standard Calibrations of pressure gauge	5	10	33	43
Total			28	84	112

11.17 Plant Supervision

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.17.1	Supervise the Operations of Batching Plants	5	17	33	50
11.17.2	Supervise the Operations of Asphalt concrete Plants	5	18	36	54
11.17.3	Supervise the Operations of Aggregate Crushing Plants	5	17	39	56
Total			52	108	160

11.18 Safety Management

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.18.1	Evaluate Air Pollution	5	15	21	36
11.18.2	Determine Noise Pollution	5	9	15	24
11.18.3	Manage Safety at Construction Site	5	9	27	36
Total			33	63	96

11.19 Inspection Techniques

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.19.1	Conduct Geotechnical Site Investigations	5	9	21	9
11.19.2	Supervise sampling, inspections and testing at construction sites	5	11	27	11
11.19.3	Plan & conduct the inspection of construction materials, products & processes.	5	8	36	8
11.19.4	Assess construction faults in buildings	5	4	12	4
11.19.5	Develop maintenance plan for roads	5	7	9	7
Total			39	105	144



9.20 Hydraulics Engineering

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
9.20.1	Determine Hydrostatic pressure	5	15	27	42
9.20.2	Apply Hydro kinematic Principles	5	21	33	54
Total			36	60	96
Grand Total of Level-5 Part-1			188	420	608

Construction Material Supervisor Level-5 Part-II

11.21 Lab Management

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
9.21.1	Plan and organize the laboratory work.	5	10	18	28
9.21.2	implement Laboratory Quality control Procedures	5	18	30	48
9.21.3	Analyse Data and report results	5	27	45	72
9.21.4	Apply quality system and continuous improvement processes	5	10	18	28
Total			65	111	176

11.22 Inspection and Testing of Concrete Structures

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.22.1	Perform NDT by rebound hammer and Rebar Detector test	5	3	12	15
11.22.2	Perform Ultrasonic pulse velocity and Penetration Test (Windsor Probe)	5	5	9	14
11.22.3	Perform NDT Pull out Test and Profometer test	5	2	12	14
11.22.4	Perform rebound hammer test and Rebar Detector test (NDT) for RCC Bridge	5	2	10	12
11.22.5	Perform Ultrasonic pulse velocity test and Penetration test by Windsor probe for concrete Bridge	5	3	9	12
11.22.6	Perform Pull out test and Profometer test on RCC Bridge	5	3	10	13
11.22.7	Perform Flat Jack Test and Impulse Radar Test	5	5	21	26
11.22.8	Perform Stress rupture Test and Creep Test on pipes	5	3	7	10
11.22.9	Perform Full Notch Creep Test and Small-scale steady-state test	5	3	7	10
11.22.10	Conduct Tensile Test, Compression Test and Leakage Detection Test	5	3	6	9
11.22.11	Conduct hydraulic pressure test and 3 edge bearing test on RCC pipes	5	3	6	9
Total			35	109	144

**11.23 Inspection and Testing of Steel Structures**

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.23.1	Perform Hardness Test on metals using Rockwell Method	5	3.5	7.5	11
11.23.2	Perform Hardness Test on metals using Brinell Method	5	2	7	9
11.23.3	Conduct Impact test on metals	5	3	9	12
11.23.4	Conduct Bend test on metals	5	4.5	7.5	12
11.23.5	Conduct Tensile Test on Metals Using Young's Modulus Apparatus	5	4.5	7.5	12
11.23.6	Conduct Tensile Test on Metals Using UTM	5	4.5	7.5	12
11.23.7	Conduct Torsion Tests on metals	5	4.5	7.5	12
11.23.8	Perform Radiographic and Ultrasonic Testing on Steel Bridges	5	3	9	12
11.23.9	Perform Dye Penetrant Inspection or Liquid Penetrant Inspection (LPI) on Steel Bridges	5	3	9	12
11.23.10	Perform Magnetic Particle Inspection on Steel Bridges	5	4	6	10
11.23.11	Perform Eddy Current Testing on Steel Bridges	5	2.5	4.5	7
11.23.12	Perform Visual Inspection on Steel Bridges	5	2	5	7
Total			41	871	128

11.24 Entrepreneurial Skills

No.	Name of Occupations and Competency Standards	Level	Contact Hour		
			Th	Pr	Total
11.24.1	Investigate micro business opportunities	5	6	9	15
11.24.2	Develop a micro business proposal	5	8	9	17
11.24.3	Develop a marketing plan	5	6	12	18
11.24.4	Develop and review a business plan.	5	6	12	18
11.24.5	Organize finances for the micro business	5	6	12	18
11.24.6	Manage human resources	5	4	6	10
11.24.7	Market products and services	5	4	12	16
11.24.8	Monitor and review business performance	5	4	12	16
11.24.9	Negotiate for resolving business issues	5	4	12	16
Total			48	96	144
Grand Total of Level 5 Part-2			189	403	592
Grand Total of Level 5			377	823	1200

4. Date of Validation

The level 5 of National qualification on construction Materials Supervisor has been validated by the Qualifications Development Committee (QDC) members on **04-08-2020 to 08-08-2020** and will remain valid for 10 years



5. Codes of Qualifications

The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analyzing cross-nationally comparable statistics on education and training. ISCED codes for these qualifications are assigned as follows:

ISCED Classification for Construction Materials Testing level-5	
Code	Description
	Level 2 National Qualification Certificate, in “construction Materials Sampler”
	Level 3 National Qualification Certificate, in “construction Materials Assistant”
	Level 4 National Qualification Certificate, in “construction Materials Technician”
	Level 5 National Qualification Diploma, in “construction Materials Supervisor”

6. Members of Qualifications Development Committee

The following members participated in the qualification’s development and validation of these qualifications:

S#	Name	Designation	Organization
1	Engr. Azhar Iqbal Shad	Principal	GCT Raiwnd Road, LHR
2	Mr. Nadeem Zaigham	Senior Instructor	GCT Raiwnd Road, LHR
3	Mr. Imtiaz Ahmad Awan	Sr. Instructor Civil	GCT Rasul (M.B.Din)
4	Muhammad Amjad Rafique	Sr. Instructor Civil	GCT Rasul (M.B.Din)
5	Mr. Liaquat Ali Sajid	Sr. Instructor Civil	GCT Rasul (M.B.Din)
6	Engr. Arslan Hameed	Research, Associate Officer	Planning & Project Deptt. Lahore
7	Engr. Ayub Nasir	Site Material Testing Engr.	Ex. FWO Islamabad
8	Engr. Inayat ur Rehman	DACUM, Facilitator	Peshawar
9	Muhammad Ishaq	QDC Coordinator	NAVTTTC, Islamabad

7. Members of Qualifications Validation Committee

The following members participated in the qualification’s development and validation of these qualifications:

S#	Name	Designation	Organization
1	Engr. Azhar Iqbal Shad	Principal	GCT Raiwind Road, LHR
2	Mr. Nadeem Zaigham	Senior Instructor Civil	GCT Raiwind Road, LHR
3	Mr. Imtiaz Ahmad Awan	Senior Instructor Civil	GCT Rasul (M.B.Din)
4	Mr. Muhammad Amjad Rafique	Senior Instructor Civil	GCT Rasul (M.B.Din)
5	Engr. Abdul Rasheed	Associate Professor Civil	GCT Peshawar KPTEVTA



6	Engr. Norheen Amina	Consultant	Allied Engg Services/ Lahore
7	Engr. Rebab Maria Mahmood	Site Engineer	IMC Lahore/ Industry
8	Engr. Habiba Mohsin	Project Manager	Jers Engg Lahore/ Industry
9	Mr. Muhammad Dawood Bashir	STI	GCT Mirpur AJK TEVTA
10	Mrs. Syeda Fatima Iqbal	Representative	PBTE Lahore
11	Mr. Liaqat Ali Jhamroo	Representative	STEVTA
12	Engr. Inayat ur Rehman	DACUM, Facilitator	Peshawar
13	Mr. Muhammad Ishaq	QDC Coordinator	NAVTTTC, Islamabad

8. Entry Requirements

The entry for National Diploma level 5, in Construction Materials Testing Technology are

1. A person having National Vocational Certificate level 4, in Construction Materials Testing Technology for entry in level 5.

9. Scheme of Studies

Construction Material Testing Technology Level-5 Part-I

S#	Occupation/ Subjects	Category	Total Contact Hours			Credit	Periods Per Week			No. of Weeks
			Th	Pr.	Total		Th	Pr	Total	
11.16	Calibration Techniques	Technical	28	84	112	11.2	2	5	7	16
11.17	Plant Supervision	Technical	52	108	160	16	4	6	10	16
11.18	Safety Management	Technical	33	63	96	9.6	2	4	6	16
11.19	Inspection Techniques	Technical	39	105	144	14.4	2	7	9	16
11.20	Hydraulics Engineering	Technical	36	60	96	9.6	3	3	6	16
		Allied								
	Total		188	420	608	60.8	13	25	38	

Construction Material Testing Technology Level-5 Part-II

S#	Occupation/ Subjects	Category	Total Contact Hours			Credit	Periods Per Week			No. of Weeks
			Th	Pr.	Total		Th	Pr	Total	
11.21	Lab Management	Technical	65	111	176	17.6	5	6	11	16
11.22	Inspection and Testing of Concrete Structures	Technical	35	109	144	14.4	3	6	9	16
11.23	Inspection and Testing of Steel Structures	Technical	41	87	128	12.8	4	4	8	16
11.24	Entrepreneurial Skills	Generic	48	96	144	14.4	3	6	9	16
		Allied								
	Total		189	403	592	59.2	15	22	37	
	Grand Total of Level 5		377	823	1200	120	30	45	75	



10. A- Occupation Packaging of Construction Materials Testing

S.#	Name of Occupation	Level	Generic Skills	Core Skills
1.	Building Materials Sampler	2	11.2.1,11.2.4, 11.2.5	11.1.01, 11.1.02, 11.1.03, 11.1.05, 11.2.6
2.	Highway Materials Testing Sampler	2	11.2.1,11.2.4, 11.2.5	11.1.01, 11.1.03, 11.1.04, 11.1.05, 11.1.06, 11.2.6
3.	Building Materials Assistant	3	11.6.4, 11.6.5, 11.4.5	11.4.1 to 11.4.4, 11.6.1, 11.7.1, 11.7.2
4.	Highway Materials Testing Assistant	3	11.6.4, 11.6.5, 11.4.5	11.4.1 to 11.4.2, 11.2.4, 11.6.1, 11.9.1 to 11.9.5
5.	Building Materials Technician	4	11.12.5, 11.12.7, 11.24.3	11.10.1 to 11.10.6, 11.14.1 to 11.14.10, 11.15.1 to 11.15.4, 11.16.1 to 11.16.3, 11.21.3, 11.23.1 to 11.23.6.
6.	Highway Quality Control Inspector	4	11.12.5, 11.12.7, 11.24.3	11.9.1 to 11.9.9, 11.13.1 to 11.13.7, 11.16.1 to 11.16.3, 11.19.2, 11.21.3
7.	Bridge Inspector (NDT)	4	11.12.5, 11.12.7, 11.24.3	11.22.1 to 11.22.11, 11.23.1 to 11.23.12
8.	Public Health Quality Control Inspector	4	11.12.5, 11.12.7	11.11.1 to 11.11.5, 11.22.8 to 11.22.10
9.	Construction Plants Operator	4	11.12.5, 11.12.7, 11.24.3	11.13.8, 11.17.1 to 11.17.3
10	Field Testing Lab Assistant	3	11.6.1, 11.6.3, 11.6.4, 11.6.5	11.4.1, 11.1.1, 11.1.3, 11.1.4, 11.1.5, 11.1.6, 11.3.8, 11.9.1 11.9.4, 11.10.1, 11.10.3, 11.14.1 to 11.17.3
11.	Field Testing Lab Technician	4	11.2.6, 11.2.8, 11.2.9, 11.2.10, 11.2.11,11.2.15,	11.4.1, 11.1.2, 11.1.3, 11.1.4, 11.1.5, 11.1.6, 11.4.3, 11.4.4, 11.3.8, 11.9.1, 11.9.3, 11.9.4, 11.9.8, 11.10.1 to 11.10.3, 11.10.5, 11.14.1, 11.14.3

10. B-Qualification Packaging of Construction Materials Testing

S.#	Name of Qualification	Level	Generic Skills	Core Skills
1	Construction Materials Sampler	2	11.2.1 to 11.2.5	11.1.1 to 11.1.6, 11.2.6, 11.3.1 to 11.3.8



2	Construction Materials Assistant	3	11.4.5, 11.6.1 to 11.6.6	11.4.1 to 11.4.5, 11.5.1 to 11.5.4, 11.7.1 to 11.4.3
3	Construction Materials Technician	4	11.12.1 to 11.12.8	11.8.1 to 11.8.7, 11.9.1 to 11.9.9, 11.10.1 to 11.10.6, 11.11.1 to 11.11.5, 11.13.1 to 11.13.8, 11.14.1 to 11.14.10, 11.15.1 to 11.15.4
4	Construction Materials Supervisor	5	11.24.1 to 11.24.9	11.16.1 to 11.16.3, 11.17.1 to 11.17.3, 11.18.1 to 11.18.3, 11.19.1 to 11.19.5, 11.20.1 to 11.20.2, 11.21.1 to 11.21.4, 11.22.1 to 11.22.11, 11.23.1 to 11.23.12



11. Detail of Qualifications and its Competency Standards

D. National Diploma Certificate Level 5 in Construction Material Supervisor

11.16. Calibration

11.16.1 Perform Standard Calibration of pH meter

Overview: This competency standard covers the skills and knowledge required to perform calibration of instruments in accordance with the reference standards and procedure.

Competency Units	Performance Criteria
CU1. Prepare items for calibration	P1. Select the pH mode P2. Adjust the temperature control at 25°C P3. Identify hazards and use appropriate personal protective equipment (PPE), safety equipment and procedures P4. Confirm pH meter meets the laboratory's specification requirements and complies fully with the calibration procedure P5. Assemble and set up specified reference standards P6. Verify performance of reference standards and measuring pH meter prior to use and adjust or calibrate as necessary
CU2. Perform calibration	P1. Startup pH meter P2. Rinse the electrode with deionized water P3. Dry it with the piece of tissue P4. Place the electrode in the sample to be tested P5. Allow the display to stabilize before taking reading P6. Remove the electrode from the buffer P7. Record all calibration data accurately and legibly P8. Compare data with specifications P9. Return to store out-of-calibration equipment
CU3. Perform calibration checks	P1. Perform individual pH tests without variance according to the documented procedure to ensure repeatability of measurement P2. Confirm readings are the result of a valid measurement and record data as required P3. Adjust pH meter under test to bring readings within



	specification and record data where required P4. Analyse resulting test data to detect trends or inconsistencies
CU4. Document the calibration	P1. Prepare and issue a final report on the job/item P2. Record the results of each pH test/calibration P3. Ensure confidentiality of workplace information P4. Attach calibration labels, quality control tags and tamper resistant seals P5. Store pH equipment/measurement standards and results

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Performance of pH testing for tap water, wastewater, soft drinks, drain water and canal water
- K2.** Define calibration, accuracy and precision
- K3.** Describe the concept of precision and accuracy regarding measuring tools and equipment
- K4.** Describe use of pH meter.
- K5.** State procedure of testing pH value by pH meter
- K6.** Describe how to calculate the least count/ resolution of pH meter
- K7.** State performance of pH testing for tap water, wastewater, soft drinks, drain water and canal water
- K8.** Describe how to ascertain the reliability or repeatability or standard deviation of a measuring instrument.
- K9.** State basic calibration principles, determination of deviation from standard and ascertain the correction i.e. zero and span adjustment
- K10.** Prepare the periodic calibration record of pH testing
- K11.** Explain Statistical analysis of quality control data, mean, median, mode, ranges and standard deviations
- K12.** Explain commonly used reference materials and working standards:

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Safely and accurately calibrated a minimum of three types of pH meters.



- Calibrations must be carried out in accordance with standard calibration procedures and documented test methods.

TOOLS AND EQUIPMENT'S

1. Balance
2. Thermometer
3. Thermocouple
4. pH meters of different types
5. incubator/oven/fridge
6. digestion block
7. biological safety cabinet
8. Fume cupboard.

11.16.2 Perform Standard Calibration of Weighing Balance

Overview: This competency standard covers the skills and knowledge required to perform calibration of instruments in accordance with the reference standards and procedure.

Competency Units	Performance Criteria
CU1. Prepare items for calibration	P1. Select the weighing balance P2. Identify hazards and use appropriate personal protective equipment (PPE), safety equipment and procedures P3. Confirm all measuring equipment meets the laboratory's specification requirements and complies fully with the calibration procedure



	P4. Assemble and set up specified reference standards and associated equipment prior to weighing balance testing P5. Verify performance of reference standards and measuring equipment prior to use and adjust or calibrate as necessary
CU2. Perform calibration	P1. Startup weighing balance according to operating procedures P2. Start with zeroing the weighing balance without any load P3. Set the loads of first test point P4. Wait for stabilization P5. Record the indication P6. Apply more loads on increasing test points P7. Check maximum load applied P8. Start decreasing the loads on decreasing test points P9. Check the accuracy/calibration of weighing balance P10. Return to store out-of-calibration equipment
CU3. Perform calibration checks	P1. Perform individual tests without variance according to the documented procedure to ensure repeatability of measurement P2. Confirm readings of weighing balance are the result of a valid measurement and record data as required P3. Adjust weighing balance under test to bring readings within specification and record data where required P4. Analyse resulting test data to detect trends or inconsistencies
CU4. Document the calibration	P1. Prepare and issue a final report on the job/item P2. Record the results of each test/calibration P3. Ensure confidentiality of workplace information P4. Attach calibration labels, quality control tags and tamper resistant seals P5. Store test equipment/measurement standards and results

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** The concept of precision and accuracy regarding measuring tools and equipment



- K2.** Calculate the least count/ resolution of weighing balances
- K3.** State types of calibration
- K4.** Describe types and uses of weighing balances used for construction
- K5.** Types of Instrument calibration
- K6.** State the calibration interval
- K7.** State Temporary set up of weighing balances
- K8.** State calibration standards
- K9.** Ascertain the reliability or repeatability or standard deviation of a measuring instrument.
- K10.** State procedure of calibration checks for weighing balances
- K11.** State analysis of calibration check data for weighing balances
- K12.** Commonly used reference materials and working standards for calibration of weighing balances:
- K13.** Explain the procedure of preparing documents required calibration results of digital and mechanical weighing balances.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Safely and accurately calibrated a minimum of four different weighing balances.
- Calibrations must be carried out in accordance with standard calibration procedures and documented test methods.

TOOLS AND EQUIPMENT'S

1. Weighing balances- mechanical and digital balances
2. thermometer
3. thermocouple
4. incubator/ oven/ fridge
5. digestion block
6. biological safety cabinet
7. fume cupboard.



11.16.3 Perform Standard Calibration of Pressure Gauge

Overview: This competency standard covers the skills and knowledge required to perform calibration of instruments in accordance with the reference standards and procedure.

Competency Units	Performance Criteria
CU1. Prepare items for calibration	P1. Select the pressure gauge P2. Identify hazards and use appropriate personal protective equipment (PPE), safety equipment and procedures P3. Confirm the pressure gauge meets the laboratory's specification requirements and complies fully with the calibration procedure P4. Assemble and set up specified reference standards and associated equipment prior to pressure gauge testing P5. Verify performance of reference standards and measuring equipment prior to use and adjust or calibrate as necessary
CU2. Perform calibration	P1. Startup equipment according to operating procedures P2. Set the pointer to read zero on the scale before applying any pressure on the gauge P3. Apply the full range pressure on the gauge P4. Adjust the linkage P5. Reduce the pressure to zero and check the pointer reading P6. Check the pressure gauge reading at 0, 50% and maximum scale reading P7. Note down the readings of the gauge on a calibration sheet P8. Draw a graph of the gauge readings and the applied readings P9. Compare data with specifications and/or previous records to identify non-compliant equipment P10. Return to store out-of-calibration equipment
CU3. Perform calibration checks	P1. Perform individual tests without variance according to the documented procedure to ensure repeatability of measurement P2. Confirm readings are the result of a valid measurement and record data as required P3. Adjust pressure gauge under test to bring readings within specification and record data where required P4. Analyse resulting test data to detect trends or inconsistencies



CU4. Document the calibration	P1. Prepare and issue a final report on the job/item P2. Record the results of each test/calibration P3. Ensure confidentiality of workplace information P4. Attach calibration labels, quality control tags and tamper resistant seals P5. Store pressure gauge equipment/measurement standards and results
--------------------------------------	--

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Describe types and uses of pressure gauges used for construction
- K2.** State the calibration interval for pressure gauges
- K3.** State Temporary set up of pressure gauges
- K4.** State calibration standards for pressure gauges
- K5.** State Temporary set up of pressure gauges
- K6.** Explain the procedure of preparing documents required calibration results of digital and mechanical pressure gauges.
- K7.** Ascertain the reliability or repeatability or standard deviation of a pressure gauge.
- K8.** Basic calibration principles, determination of deviation from standard and ascertain the correction i.e. zero and span adjustment such as for pressure gauge
- K9.** Prepare the periodic calibration record of testing
- K10.** Commonly used reference materials and working standards for pressure gauges:

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Safely and accurately calibrated a minimum of three different pressure gauges.
- Calibrations must be carried out in accordance with standard calibration procedures and documented test methods.

TOOLS AND EQUIPMENT'S

1. balance
2. thermometer
3. thermocouple
4. viscosity meter



5. flow meter (including digital)
6. pressure gauges
7. incubator/oven/fridge
8. digestion block
9. biological safety cabinet
10. Fume cupboard.



11.17. Plant Supervision

11.17.1 Supervise the Operations of concrete Batching Plants

Overview: This competency standard covers the skills and knowledge required to supervise and monitor the operations of Concrete Batching plant.

Competency Units	Performance Criteria
CU-1 Monitor the Concrete Batching Plant	P1. Check the availability of materials P2. Turn the batch plant ON/OFF and adopt PPEs P3. Observe the Operational procedure P4. Check batching plant automatic and manual mode P5. Observe the Control panel of the plant
CU-2 Carryout pre-Operation checks on Concrete Batching plant	P1. Follow standard ratio amongst ingredients for cement concrete. P2. Turn on concrete batching plant P3. Insert the desired formula on the control panel P4. Compute the weight error in plant if any P5. Remove the error as needed
CU-3 Analyze Raw Materials for cement concrete.	P1. Collect samples from aggregate stacks P2. Perform grading of aggregate P3. Collect cement sample P4. Collect water samples P5. Record test results
CU-4 Produce Concrete with Batching Plant	P1. Check required raw material s P2. Inspect the conveyer belts P3. Monitor batching operations P4. Check the loss of raw material P5. Organize workflow for delegated tasks P6. Produce concrete by operation of plant P7. Prepare the Raw Materials Consuming summary sheet P8. Prepare batching materials production summary sheet
CU-5 Perform post-operation checks for concrete batching plant	P1. Prepare for post operation procedures of concrete batching plant. P2. Carryout post-operation checks for batching plant.



	P3. Adopt PPEs P4. Perform strength Test on cube P5. Perform strength Test on Cylinder P6. Perform Slump Test P7. Record test result
--	--

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge to,

- K1.** Explain the working of Concrete Batching Plant (Automatic and Manual) type
- K2.** Explain the working principles of Concrete Batching Plants
- K3.** Describe the operational procedures of Concrete Batching Plant
- K4.** Explain post operation procedure for concrete batching plant
- K5.** Explain the post operation Checks the operational properties for Batching Plant.

Critical Evidence(s) required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Calibrate the Concrete Batching Plant
- Prepare Summary for consumable raw materials at Batching Plant.
- Prepare Summary for production at Batching Plant.
- Check the operational properties at Batching Plant.

TOOLS AND EQUIPMENT'S

1. balance
2. Concrete Batching plant
3. thermocouple
4. Slump cone apparatus
5. Sampling equipments for concrete and its ingredients
6. Water tank
7. Moulds- cube, cylinder,
8. Compression testing machine



9. Curing chambers
10. Sampling kits,
11. Equipments for cement testing
12. Equipments for aggregate testing
13. Equipments for water testing



11.17.2 Supervise the Operations of Asphalt Concrete Plants

Overview: This competency standard covers the skills and knowledge required to supervise and monitor the operations of Asphalt concrete plant.

Competency Units	Performance Criteria
CU-1. Monitor the Asphalt Concrete Plant	P1. Check the availability of materials P2. Turn the batch plant ON/OFF P3. Observe the Operational procedure P4. Check batching plant automatic and manual mode P5. Observe the Control panel of the plant
CU-2. Carryout pre-Operation checks on Asphalt Concrete plant	P1. Follow standard ratio amongst ingredients for asphalt concrete. P2. Turn on Asphalt plant and adopt PPEs P3. Insert the desired formula on the control panel P4. Compute the weight error in plant if any P5. Remove the error as needed P6. Monitor the temperature of the asphalt Plant
CU-3. Analyze Raw Materials for Asphalt Concrete	P1. Collect samples from aggregate stacks P2. Perform grading of aggregate P3. Collect Asphalt sample P4. Record raw materials quantity
CU-4 Produce with concrete Asphalt Concrete Plant	P1. Check required raw material s P2. Inspect the conveyer belts P3. Monitor batching operations P4. Check the loss of raw material P5. Set goals for better production P6. Organize workflow for delegated tasks P7. Produce asphalt concrete by operation of asphalt plant. P8. Prepare the Raw Materials Consuming summary sheet P9. Prepare batching materials production summary sheet
CU-5 Perform Post operations checks and Perform Quality control Tests for Asphalt Concrete	P1. Identify sample P2. Adopt PPEs P3. Perform binder content test. P4. Perform Ductility test. P5. Softening point test.



	P6. Flash and Fire point test. P7. Float test. P8. Record test results
--	--

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge to,

- K1.** Explain the working of Asphalt Concrete Plant (Automatic and Manual) type
- K2.** Explain the working principles of Asphalt Concrete Batching Plants
- K3.** Describe the operational procedures of Asphalt Concrete Batching Plant
- K4.** Explain how to monitor batching operations.
- K5.** Explain the sequence of operations of asphalt plant.
- K6.** Describe the pre operation tests of raw materials for Asphalt Concrete Plant
- K7.** Explain post operation quality control tests of asphalt concrete.
- K8.**

Critical Evidence(s) required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Calibrate the Asphalt Batching Plant
- Prepare Summary for consumable raw materials at Batching Plant.
- Prepare Summary for production at Batching Plant.
- Check the operational properties at Batching Plant.

TOOLS AND EQUIPMENT'S

1. balance
2. Asphalt Batching plant
3. Aggregate gradation apparatus
4. Binder contents test apparatus.
5. Ductility test apparatus.
6. Softening point test apparatus.
7. Flash and Fire point test apparatus.



8. Float test apparatus.
9. Water tank
10. Sampling kits,



11.17.3 Supervise the Operations of Crushing Plants

Overview: This competency standard covers the skills and knowledge required to supervise and monitor the operations of Crushing of Aggregate at plant.

Competency Units	Performance Criteria
CU-1. Monitor the Aggregate Plant	P1. Check the availability of materials P2. Turn the crushing plant ON/OFF P3. Observe the Operational procedure P4. Check for pre-operation. P5. Observe the Control panel of the crusher
CU-2. Carry out pre-Operation checks of Aggregate Crushing plant	P1. Turn on crushing plant and adopt PPEs P2. Observe the Operational procedure of the plant P3. Feed desired speed as per quality of stone P4. Check the quality of raw material P5. Inspect the Crusher jaws P6. Inspect the conveyer belts
CU-3. Produce stone crush by Crushing Plant	P1. Check required raw material s P2. Inspect the conveyer belts P3. Check the loss of raw material P4. Set goals for better crushing P5. Organizing workflow for delegated tasks P6. Monitor crushing operations P7. Monitoring employee productivity P8. Prepare the Raw Materials Consuming summary sheet P9. Prepare batching materials production summary sheet
CU-4. Carryout post-operation checks for crushing plant.	P1. Prepare for post operation procedures of crushing plant. P2. Carryout post-operation checks for crushing plant. P3. Adopt PPEs P4. Perform aggregate crushing strength / value test. P5. Record test results

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge to,



- K1.** Explain the working of Aggregate Crushing Plant (Automatic and Manual) type
- K2.** Explain the working principles of Aggregate Crushing Plants
- K3.** Describe the operational procedures of Aggregate Crushing Plant

Critical Evidence(s) required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Calibrate the Aggregate Crushing Plant
- Prepare Summary for consumable raw materials at crushing Plant.
- Prepare Summary for production at crushing Plant.
- Check the operational properties at crushing Plant.

Tools and Equipment

1. Crushing Plant.
2. PPEs
3. Multimeter
4. Circuit Diagrams for Crushing plant
5. Digital Balance
6. Digital Thermometer
7. GI Tray
8. Spatula
9. Knife edge
10. Digital Stop Watch
11. Weighing Pan
12. Testing equipment
13. Crushing plant kit.



11.18. Safety Management

11.18.1 Evaluate Air Pollution

Overview: This competency standard covers the skills and knowledge required to analyze sources of air pollution, analyze methods of detection/measurement of air pollution, evaluate environment quality standards in ambient air, analyze methods to control air pollution and evaluate pathological effects of air pollution on human life

Competency Units	Performance Criteria
CU1. Analyze sources of air pollution	P1. Identify air pollutants P2. Identify sources of air pollutants P3. Gather information about emission of pollutants P4. Compile data in a presentable form
CU2. Monitor methods to detection of air pollution	P1. Prepare sampling sites P2. Select the source of air pollution P3. Identify instruments for detection air pollution P4. Operate instrument P5. Measure air pollutants P6. Record result and assemble it
CU3. Monitor air pollution from chimneys	P1. Identify instrument to measure smoke from chimney P2. Operate the instrument P3. Measure air pollution P4. Record the readings P5. Collect the data and assemble it on note pad
CU4. Monitor air pollution of automobiles	P1. Identify instrument to measure smoke P2. Operate the instrument P3. Measure pollution P4. Record the readings and assemble it on note pad
CU5. Monitor air pollution from different industries	P1. Select industries producing smoke P2. Identify the instrument for detection of industries smoke P3. Operate instruments to measure smoke P4. Record and save the results data



CU6. Evaluate environment quality standards in ambient air	P1. Identify instruments P2. Collect environment quality standards (EQS) in ambient air for different areas P3. Compare the site readings with EQS P4. Record and save the results data
CU-47 Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose off waste Material P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to develop understanding to analyze sources of air pollution, analyze methods of detection/measurement of air pollution, evaluate environment quality standards in ambient air, analyze methods to control air pollution and evaluate pathological effects of air pollution on human life and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Define air pollution
- K2.** Enlist different air pollutants
- K3.** Describe emission of air pollutants.
- K4.** Enlist method of detection of air pollution
- K5.** Enlist sources of air pollution
- K6.** Common air pollutants, their sources and pathological effects on man
- K7.** Name instruments for detection of air pollution
- K8.** Enlist instrument for determining air pollution from industries
- K9.** Describe working procedure of instrument
- K10.** Enlist instrument for determining air pollution from chimneys
- K11.** Describe working procedure of instrument
- K12.** Enlist instrument for determining air pollution from automobile
- K13.** Describe working procedure of instrument

Critical Evidence(s) Required



The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Tools and Equipment

1. Pencil
2. Charts
3. Eraser
4. Air quality meter
5. Air beam



11.18.2 Determine Noise Pollution

Overview: This competency standard covers the skills and knowledge required to measure the noise pollution, compare the standards and control noise pollution.

Competency Units	Performance Criteria
CU1. Measure the noise pollution	P1. Select site P2. Select sources producing noise P2. Identify instruments for recording noise P3. Operate the sound level meter P4. Record the readings P5. Collect data and assemble it on notepad
CU2. Measure the noise at construction site	P1. Use noise dosimeter P2. Operate Noise dosimeter P3. Record the readings P4. Collect data and assemble it on notepad
CU3. Measure the noise of traffic	P1. Use optimus sound level meter P2. Operate optimus sound level meter P3. Record the readings P4. Collect data and assemble it on notepad
CU4. Compare the standards noise pollution	P1. Collect WHO guidelines P2. Compare the recorded readings with WHO P3. Identify the readings that lies within WHO
CU5. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose off waste Material P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to develop understanding to measure the noise pollution, compare the standards and control noise pollution and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:



- k.1 Define noise pollution
- k.2 Sources of noise Pollution (Noise from traffic, Aircraft noise, Noise from construction and civil engineering works, Noise from industry)
- k.3 Measurements of intensity of sound
- k.4 State acceptable limit of noise according to WHO
- k.5 Effects of noise on peoples" lives
- k.6 Control of noise pollution
- k.7 Define noise from traffic
- k.8 Enlist sources of noise from traffic
- k.9 Define sound level meter
- k.10 Enlist sources of noise at construction site
- k.11 Name different equipment used to measure noise
- k.12 Enlist sources of noise pollution
- k.13 Enlist various method for measuring noise pollution
- k.14 Instruments for detection of noise pollution

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Measure the noise at construction site as per standards
- Measure the noise of traffic as per standards
- Compare the standards noise pollution

Tools and Equipment

1. Sound level meter
2. Pencil
3. Charts
4. Eraser
5. Noise dosimeter



11.18.3 Manage Safety at Construction Site.

Overview: This competency standard covers the skills and knowledge required to comply with regulatory and organizational requirements for occupational health and safety at construction site.

Competency Units	Performance Criteria
CU1. Evaluate hazards and risk at work place	P1. Identify physical hazards at work place P2. Check noise level at work place P3. Check adequacy of ventilation at work place P4. Examine the illumination level at work place P5. Examine the storage of hazardous materials as per MSDS P6. Analyze the risk indicators of hazards. P7. Adopt preventive / corrective measures in accordance with HSE Policy
CU2. Ensure safe work practice at site	P1. Ensure safe use of tools and tackles by the workers as per applicability. P2. Ensure appropriate use of Personal Protective Equipment (PPE) P3. Ensure that health and safety plan is followed by all subordinates. P4. Implement safe handling and stacking methods at workplace / store P5. Confirm that all required signs are posted, and bulletin boards are maintained in clear and legible condition. P6. Carry out safety walks/ inspections in order to observe the physical conditions of work and the work practices and procedures followed by workers. P7. Ensure all un-protected openings are adequately guarded or barricaded. P8. Encourage workers to identify unsafe or unhealthful workplace conditions and report the every near-miss. P8. Ensure safe access is available at work place for movement of workers & materials.
CU3. Report and investigate the accident at construction site.	P-1 Check there is no immediate risk of danger at work place. P-2 Ensure that victim of accident received the first aid. P-3 Report to the manager.



	P-4 Secure the accident site by shutting down or blocking the area. P-5 Collect the information about the incident before the witnesses begin to forget details. P-6 Trace the lacking in work procedure and deficiencies in safety measures. P-7 Analysis by step-by-step recounting of the incident and to root cause of accident. P-8 Develop the incident report along with corrective measures to avoid future accident.
CU4. Develop emergency response protocol / procedures	P-1 Collect detail drawing of the building/construction site. P-2 Analysis the physical conditions, work practices, procedures and processes to ascertain the hazards and associated risks level. P-3 Propose emergency exit, escape route and assembly point. P-4 Prepare the marking scheme for work area and walking area in the lab floor. P-5 Select the positions for fire alarm, fire extinguishers, smoke detector, Safety signs, safety signals and fire hydrants etc. P-6 Draw emergency response plans. P-7 Establish emergency response lead team. P-8 Conduct emergency response drill for assessing the deficiencies and review the emergency response plan & procedures.
CU5. Implement the emergency response procedures.	P-1 Carry out special tool box talks which require discussion on highly critical safety related matters, hazardous site conditions pertaining to particular work etc. P-2 Ensure effective adherence to response to emergency procedures / protocols P-4 Train workers about hazards, methods to prevent harm and the awareness of HSE standards so they can perform their work safely. P-5 Conduct the emergency related drills; fire drill, evacuation drill earthquake drill, basic life support/CPR, first aid and Spillage control drills etc.



	P-6 Implement control measures to reduce risk & meet legal requirement as per organizational policies.
--	---

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1** Explain emergency safety control measures and actions to be taken under emergency situation
- K2** Identification of unsafe act and unsafe conditions
- K3** Describe the classification of fire and use of fire protection devices.
- K4** Standard procedure of handling, storing and stacking material
- K5** Safe disposal of waste, type of waste and their disposal
- K6** Basic ergonomic principles as per applicability
- K7** Reporting procedures in cases of breaches or hazards for site safety, accidents, and emergency situations as per guidelines
- K8** Appropriate personal protective equipment to used based on various
- K9** Use hazardous material, in a safe and appropriate manner as per applicability
- K10** Limits of responsibility for identifying site accidents or injuries
- K11** Procedure involved for obtaining HSE permit.
- K12** Procedure to maintain emergency response
- K13** Explain tolerance levels for site environment to monitor levels of dust, air pollution, noise pollution, etc.
- K14** Process of hazard analysis for construction work.
- K15** Develop the OHSE personal records such as Health records, Incident reports, Accident reports, OHSE-related training.
- K16** Implement the Safety regulations: Clean Air Act, Building code, National Electrical and Fire Safety Codes, Waste management rules, Occupational Safety and Health Standards, Pakistan Environment Protection Act 1997 etc

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Make sure not to create unsafe conditions for others
- Identify safety risks that affect the health, safety and environment for self and others working in the vicinity, tackle it if within limit or report to appropriate authority



- Ensure personal safety behavior
- Respond to emergency

TOOLS AND EQUIPMENT'S

1. Safety Helmets
2. Safety goggles
3. Hand gloves
4. Safety Shoes (Assorted size)
6. Ear Plug
8. Face mask
9. Board of Safety instructions.
10. Fire Extinguishers
11. First aid Kit
12. Stretcher
13. Safety harness
14. Safety Belts
15. Various hand / power tools
16. Fire Buckets.
17. Blankets
18. Chain Hoist
19. Hooks / Anchors
20. Slings
21. Safety net



11.19. Inspection Techniques

11.19.1 Conduct Geotechnical Site Investigations

Overview: This competency standard covers the skills and knowledge required to prepare for onsite operations, arrange excavation of boreholes, test pits and/or trenches, conduct site sampling, conduct testing, finalize site operations, maintain Records and maintain a safe work environment.

Competency Units	Performance Criteria
CU1. Prepare for onsite operations	P1. Identify the job, location, work instructions, appropriate sampling and test procedures and safety requirements P2. Identify site hazards and identify appropriate personal protective equipment (PPE) and safety procedures P3. Record description of the job to be undertaken, compare with specification and report any variations P4. Arrange for the collection, checking, stowing and transport of all tools, equipment and materials required at the site P5. Ensure site access requirements
CU2. Arrange excavation of boreholes/ test pits/ trenches	P1. Identify the sampling/testing location P2. Excavate to the sampling and testing depth P3. Excavate materials from different strata and keep them separate P4. Identify materials and record changes of strata, test results and other relevant information P5. Terminate the excavation at the appropriate depth and record the reason for termination
CU3. Conduct site sampling.	P1. Prepare and check sampling equipment and materials P2. Take disturbed and undisturbed samples P3. Label and record samples P4. Recognise and record details of site conditions
CU4. Conduct testing.	P1. Prepare and conduct pre-use checks of test equipment P2. Perform, or assist with performing, tests in accordance with test methods or workplace procedures P3. Record test data P4. Recognise obvious errors or atypical data and take appropriate corrective actions



CU5. Finalize site operations	P1. Backfill or seal any excavation P2. Reinststate surfaces disturbed by sampling or testing P3. Clean all equipment (and vehicle, as necessary) P4. Check all equipment and materials prior to re-stowing them for safe transport P5. Handle and transport samples P6. Notify appropriate site personnel on completion of investigations and prior to leaving site P7. Check serviceability of test equipment before storage on return to base
CU6. Maintain Records	P1. Maintain equipment records P2. Complete site safety plans, equipment logs and test reports Maintain confidentiality of workplace information.
CU7. Maintain a safe work environment.	P1. Use safe work procedures and PPE to ensure personal safety and that of others P2. Minimise environmental impacts of testing/sampling and generation of waste P3. Collect and/or dispose of all waste in accordance with workplace procedures

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1 Numeracy skills to:

K2 interpret maps, site plans and drawings accurately

K3 perform basic in situ tests and site measurements, including location and depth.

K4 Safety relevant to tools, tackles, & requirement as per applicability.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Conduct geotechnical site investigation.

TOOLS AND EQUIPMENT'S

- PPEs



- Site exploration tools
- Site Exploration investigation equipment



11.19.2 Supervise sampling, inspections and field testing at construction sites

Overview: This competency standard covers the skills and knowledge required to supervise the placement of materials, at a construction site, confirming the requirements of the inspection and testing plans, liaising with site personnel and organising sampling and testing activities. Collecting reliable data and reporting result, provide reliable advice to construction personnel, recognise and rectify obvious errors or unexpected results and troubleshoot common problems.

Competency Units	Performance Criteria
CU1. Prepare for on-site operations	P1. Identify the job P2. Select equipment and materials P3. Identify site hazards and the personal protective equipment (PPE) and safety procedures specified for job P4. Organize site induction for self and support personnel P5. Record description of the job to be undertaken, compare with specification and resolve any variations P6. Select suitable transport for site access P7. Brief support personnel on job-specific requirements
CU2. Establish on-site operations	P1. Determine methods of communication, roles, responsibilities and expectations of each party, including identification of potential site problems and conflicts P2. Set up facilities for supervision, testing and sample storage. P3. Inspect the site to determine the characteristics of the project, including survey control points P4. Design inspection, sampling and testing program in accordance with specifications
CU3. Supervise materials placement	P1. Conduct inspection and direct sampling P2. Direct and advise the site superintendent based on test results and observations P3. Record test data and observations P4. Send samples to the base laboratory for testing P5. Ensure cleaning of equipment Supervise the removal of equipment and materials from site
CU4. Analyze project data and report to client	P1. Document site results P2. Maintain security and confidentiality of information P3. Report test results to site superintendent



	P4. Prepare and issue a final project report detailing supervision and testing carried out, statement of compliance and relevant tables and plans as required
CU5. Promote a safe work environment	P1. Promote the use of safe work procedures and protective equipment P2. Minimise environmental impacts of testing/sampling and generation of waste P3. Promote the collection and disposal of all waste

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard.

- Principles of planning and project management
- Engineering properties of civil construction materials
- Techniques and plant and equipment used in civil construction relevant to job role
- Principles and purpose of test methods implemented
- In situ and laboratory test methods for construction materials relevant to job.
- Roles and responsibilities for different levels of site supervision
- Typical site problems and recommended corrective actions.
- Awareness of environmental sustainability issues as they relate to the work task.
- Legal, ethical and work health and safety (WHS) requirements specific to the work task including traceability, confidentiality and security requirements of all client information, and laboratory data and records.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Designed and effectively supervised inspection, sampling and testing program in accordance with specifications
- Safely direct sampling and testing in accordance with inspection and testing plans and remit of samples for testing as required.
- Collaborated with the contractor in the placement of materials, such as soil, concrete and asphalt, at a construction site.



11.19.3 Plan & conduct the inspection of construction materials, products & processes.

Overview: This competency standard covers the skills and knowledge required to create the abilities to prepare work documents and instructions for conducting inspection in accordance with standard operating procedures of the inspection body and formulates inspection plans by analyzing the scope of inspection activities, equipment used and technical information. To perform on-site inspection of construction materials & processes by examining the inspect items and samples by applying appropriate statistical techniques & inspection skills and identify any defects on the items and samples by taking accurate on-site measurements and recording on-site observations.

Competency Units	Performance Criteria
CU1. Prepare plan for conducting inspection.	P1. Identify the content or type of information to be collected during the inspection P2. Identify the need of needs of sampling and field testing. P3. Identify the set of equipment & tool required for field testing and sampling. P4. Identify potential site hazards P5. Prepare the inspection P6. Submit the inspection document to relevant parties for consultation. P7. Determine the sequence of inspection operations
CU2. Perform on site inspection & sampling.	P1 Conduct physical inspection of processes & materials in accordance with the inspection plan. P2 Identify the defects and deficiencies in product & processes and record with evidence. P3 Perform test as per standard procedure for determining the physical properties of materials and product. P4 Collect the samples of materials & products for lab testing as per sampling procedure & rules. P5 Take photos/snaps of test sites and samples. P6 Record the results of tests in the sampling document P7 Record sample appearance, environmental conditions and any other factors that may impact on sample integrity P8 Pack and seal the sample & sub-samples in the presence of



	witnesses according to sampling rule and procedure P9 Label samples in accordance with traceability requirements. P10 Complete the sampling document; fill in the sample date, time, weight/volume, sample ID, preservative used, sample location and sampler name etc. P11 Ensure activities at site are as per approved method statement such as material storage, tools & plants conditions, workmanship and safety measures etc. P12 Check the actions taken for rectification of snag list. P13 Record the non-compliance and expected breaches of contract in accordance with the policy of inspection body. P14 Record observations at site and preserve all data.
CU3. Prepare the inspection report.	P1 Ensure evidence of inspection observations and findings P2 Check calculations and data transfer accurately to ensure error-free in inspection results. P3 Verify the integrity of information supplied by other party as a part of the inspection process. P4 Apply appropriate statistical techniques to check the validity of inspection results P5 Collect and review the information relevant to inspection activities for recoding inspection results P6 Suggest the necessary corrective actions for tackling the identified problems and procedures for monitoring inspection results

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K-1.** Describe the inspection procedures such as planning, sampling, testing results recording.
- K-2.** Identify the specifications of product / process to be inspected and the production system such as significant factors, control points.
- K-3.** Identify the content or type of information to be collected during the inspection.
- K-4.** Collect and review the information relevant to inspection activities and work document preparation for recoding inspection results.
- K-5.** Describe the documentation and record system of the inspection body.
- K-6.** Describe different types of defect for inspection activities.



- K-7. Specify the sampling plan and equipment requirements.
- K-8. Identify appropriate statistical sampling techniques.
- K-9. Identify potential site hazards.
- K-10. Specify the traceability requirements of inspection items and samples.
- K-11. Describe different handling methods for inspection items and samples and procedures for monitoring inspection results,,

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Prepare work documents fit for practical use in conducting inspection efficiently
- Identify and select suitable equipment for inspection with consideration of environmental factors
- Handle inspection items and samples by appropriate methods to meet the traceability requirements
- Check the validity of inspection results by applying appropriate statistical techniques and verify the integrity of information supplied by other party,

11.19.4 Assess construction faults in buildings

Overview: This competency standard covers the skills and knowledge required to assess construction faults in buildings

Competency Units	Performance Criteria
CU1. Identify construction faults on building sites	P1. Collect information relating to the specific building construction problem. P2. Identify construction problem for the type of construction. P3. Communicate construction faults to appropriate personnel and document it. P4. Identify typical faults and problems and action to rectify is deemed to be in accordance with the Building codes.



CU2. Identify construction techniques, methods and materials nominated in relevant legislation in the Building codes and standard	P1. Use building terminology accurately in the communication of issues. P2. Identify existing construction problems P3. Identify alternative methods and materials to correct construction faults. P4. Prepare detailed sketches of available alternative methods and materials available to meet the construction aims and objectives to specification.
CU3. Construction faults in construction techniques and methods	P1. Evaluate project working drawings and specifications identifying existing or designed construction problems. P2. Prepare report identifying available alternative methods and materials to meet the construction aims and objectives to specification. P3. Prepare detailed sketches of available alternative methods and materials available to meet the construction aims and objectives to specification.
CU4. On-site Correct faults with building materials.	P1. Evaluate commonly occurring on-site problems with building materials and their causes. P2. Identify and implement corrective and preventative measures.

Knowledge & Understanding

The candidate must be able to develop skills and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1. Enlist authorities and powers of a building surveyor
- K2. Describe design and construction principles of buildings
- K3. Explain nature of materials and effect on performance
- K4. Describe processes for the administration and preparation of documentation
- K5. Describe processes for the interpretation of reports, working drawings and specifications
- K6. Explain relevant federal, state or territory legislation and local government policy and procedures

Critical Evidence(s) Required



The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Comply with OHS regulations applicable to workplace operations
- Apply organisational management policies and procedures, including quality assurance requirements where appropriate
- Assess construction faults in buildings, determine a rectification strategy and consider alternative construction methods; and the associated reporting of data, findings, recommendations and strategies for at least one residential building project and one commercial building project or equivalent in compliance with relevant legislation
- Provide reports to appropriate body/individual as determined by the project brief.



11.19.5 Develop maintenance plan for roads

Overview: This competency standard covers the skills and knowledge required to identify the defects in road and draft a management plan for road maintenance

Competency Units	Performance Criteria
CU1. Identify defects in road	P1. Enlist defects in roads P2. Analyze causes of road defects P3. Draw defects in roads
CU2. Draft a management plan for road maintenance	P1. Identify road location, design and construction requirements. P2. Check timeframe for use of the road and weather conditions. P3. Schedule personnel, material and equipment required for the construction P4. Prepare plan of operational procedures for roads. P5. Prepare plan for formal road construction/maintenance plan P6. Identify roles of individuals in maintenance of roads P2. Propose positions for different roles P4. Propose roles according to positions for maintenance of roads

Knowledge & Understanding

The candidate must be able to develop understanding to identify the defects in road and draft a management plan for road maintenance and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain defects liable to occur in road- corrugations, ruts, pot holes etc.
- K2.** Explain the remedial measures for defects- scraping of existing layers, patch repair, replacing with reinforced layers, resurfacing etc.
- K3.** Describe the causes of defects in concrete roadside pot holes, corrugations and ruts.
- K4.** Describe the repair of defects of concrete road.
- K5.** Describe recycling procedure for road used materials

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Report on defects of roads
- Management plan for maintenance of roads

Tools and Equipment



1. Drafting Table,
2. Drawing Tools
3. Drawing Sheets



11.20. Hydraulics Engineering

11.20.1 Determine Hydrostatic pressure

Overview: This competency standard covers the skills and knowledge required to find pressure by pressure gauges, Hydrostatic pressure and center of pressure of vertically immersed surface,

Competency Units	Performance Criteria
CU1. Find pressure by Piezometer	P1. Identify pressure gauge P2. Measure pressure by Piezometer
CU2. Find pressure by manometer	P1. Identify pressure gauge P2. Measure pressure by Manometer
CU3. Find out Hydrostatic pressure and center of pressure on vertically Immersed surface.	P1. Identify the apparatus P2. Immerse the apparatus in water tank P3. Apply the formulae for hydrostatic pressure and center of pressure. P4. Find the area of immersed surface P5. Find moment of inertia of the figure P6. Calculate hydrostatic pressure on surface P7. Find position of center of pressure
CU4. Find out discharge through a pipe with Pitot tube	P1. Identify the instrument P2. Fix the Pitot tube with pipe P3. Measure height of liquid in the tube P4. Find the velocity by using formula. P5. Find the discharge by using formula
CU5. Find the Metacentric height of a floating body in Lab.	P1. Identify the apparatus. P2. Put apparatus in water tank. P3. Place jokey weight to make the ship symmetrical. P4. Place the ship in water and adjust the plumb to zero mark. P5. Move jokey weight across deck to a specified distance. P6. Measure the angle of inclination. P7. Calculate the metacentric height of ship by formula.

Knowledge & understanding

K1. Define Hydraulics and state the scope and significance of Hydraulics in civil engineering.



- K2. Define density, specific weight, specific volume, specific gravity, surface tension, viscosity compressibility, cohesion, and adhesion.
- K3. State pressure, intensity of pressure, pressure head, Pascal's law and its simple applications.
- K4. Distinguish among atmospheric pressure, gauge pressure and absolute pressure.
- K5. Describe measurement of fluid pressure by Piezometer tube and different manometers.
- K6. Define Hydrostatics
- K7. State pressure on immersed surface.
- K8. Define center of pressure and resultant pressure.
- K9. Calculate the total pressure and center of pressure on a horizontal vertical and inclined surface immersed in a liquid (i.e. water)
- K10. Define the terms, buoyancy, floatation, buoyant force and center of buoyancy
- K11. Define metacenter and metacentric height.
- K12. State the kinds of equilibrium of a floating body.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to be competent in this competency standard.

- Observe and calculate the reading of piezometer.
- Calculate the liquid pressure from the piezometer reading
- Observation and calculations of hydrostatic apparatus.
- Prepare Calculation sheet for pitot tube.
- Record Observations and calculation for finding metacentric height.

Tools and Equipment

- Piezometer.
- Manometer
- Hydrostatic apparatus.
- Water tank.
- Pilot tube.
- Metacentric height apparatus
- Hydraulic bench



11.20.2 Apply Hydro kinematic Principles

Overview: This competency standard covers the skills and knowledge required to determine coefficient of discharge using venture meter, to calculate energy losses in pipe flow Determine hydraulic Co-efficient for circular orifices Calculate hydraulic and energy gradient for pipelines. Calculate flow in open channels. Calculate flows through notch Calculate flows through weirs.

Competency Units	Performance Criteria
CU1. Determine coefficient of discharge using venturi meter.	P1. Check dimensions of venturi meter and water tank. P2. Observe piezometric readings at inlet and throat P3. Open inlet valve and take piezometer readings P4. Measure the head. P5. Calculate actual discharge. P6. Calculate theoretical discharge. P7. Calculate the coefficient of discharge using formulae.
CU2. Calculate energy losses in pipe flow.	P1. Identify the apparatus. P2. Open valve and pass water through pipe. P3. Check piezometric readings P4. Draw hydraulic grade line.
CU3. Determine hydraulic Co-efficient for circular orifices	P1. Identify the orifice and adjust with the apparatus P2. Set constant head in the tank P3. Measure horizontal and vertical coordinates P4. Find actual discharge by using a container and stop watch P5. Use formulae to calculate coefficient of velocity and discharge
CU4. Calculate hydraulic and energy gradient for pipe lines.	P1. Prepare pipeline design charts using standard formulae. P2. Identify the limitations of formulae. P3. Identify variations in roughness coefficients. P4. Calculate the pressure in pipeline systems using the hydraulic gradient line. P5. Calculate the pipe discharge from reservoirs.
CU5. Calculate flow in open channels.	P1. Identify methods used for measuring flows in open channels. P2. Identify instruments to be used P3. Use formulae for calculating flows in open channels. P4. Find the velocity by current meter and velocity rod P5. Find discharge.



CU6. Calculate flows through Vee and Trapezoidal Notch.	P1. Identify the methods used for measuring flows in notches. P2. Calculate area of notch. P3. Measure head of water over the notch. P4. Use the formulae for calculating flow in notches.
CU7. Calculate flows through weirs	P1. Identify the methods used for measuring flows in notches. P2. Calculate area of weirs P3. Measure head of water over the weirs P4. Use the formulae for calculating flow in weirs

Knowledge & Understanding

- K1.** Define hydro kinematics
- K2.** State discharge and equation of continuity of a liquid flow.
- K3.** Distinguish path lines and stream lines.
- K4.** Distinguish the type of flow in pipes i.e. steady and unsteady flow, uniform and non-uniform flow, turbulent flow.
- K5.** State the term hydrodynamics.
- K6.** State the energies of liquid in motion.
- K7.** State the total head of flowing liquid and total energy.
- K8.** Explain Bernoulli's theorem with its formula, limitations and practical application i.e., venture meter & Pitot tube.
- K9.** Understand the Flow Through Pipes.
- K10.** State and explain difference between flow through pipes and open channel flow
- K11.** Distinguish types of flow in pipes i.e. steady and unsteady flow, uniform and non-uniform flow, turbulent flow.
- K12.** Explain the major and minor losses of head of water flowing through pipes.
- K13.** State Chezy's and Darcy's formulae for friction loss in pipe flow.
- K14.** Apply Chezy's & Darcy's formulae for calculation of losses in pipes.
- K15.** Explain with sketches the hydraulic gradient and total energy line under different conditions.
- K16.** Define orifice
- K17.** State types of orifices
- K18.** State the terms; jet of water, vena contracta, co-efficient of discharge, coefficient of velocity, coefficient of contraction and velocity of approach
- K19.** Derive formulae for discharge through orifices
- K20.** Differentiate between orifice and mouth piece.
- K21.** Define notch



- K22. State types of notches
- K23. State the discharge formulae for notches.
- K24. Define weir
- K25. State types of weirs
- K26. Differentiate sharp crested and broad crested weirs.
- K27. State the discharge formulae for weirs.
- K28. State the flow through open channels.
- K29. State Chezy's, Manning & s Bazin's formulae for discharge through open channel.
- K30. State most economical section of channel and condition for maximum discharge through channel.
- K31. State discharge through rectangular & trapezoidal channel section and their formulae.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to be competent in this competency standard.

- Record observations and calculations of venturimeter.
- Record Readings ,Observation and calculations of piezometer.
- Do Calculations of coefficient of velocity and discharge.
- Prepare Calculation sheet of discharge for vee and trapezoidal notch.
- Prepare Calculation sheet of discharge over weir.

Tools and Equipment

- Venturi meter
- Friction in pipes apparatus.
- Orifices.
- Vee and trapezoidal notches.
- Weirs
- Hydraulic bench



11.21. Lab Management

11.21.1 Plan and organize the laboratory work.

Overview: This competency standard covers the skills and knowledge required to plan & organize the activities for conducting the assigned testing job.

Competency Units	Performance Criteria
CU1. Pre-planning phase pertaining to Laboratories Works	P1. Identify the Scope of Laboratory works P2. Identify the ISO Quality standards P3. Recognize Quality goals of lab P4. Identify the Quality Standards for the particular tests within the Scope of Lab works. P5. Recognize the requirements stipulated within the standards to perform the test, Like Equipment, personals, lab facilities, Storage capacity and report writing. P6. Prepare SOP's in accordance with the identified requirements. P7. Prepare the process flow diagram in order to achieve Quality outcome.
CU2. Work in a team environment	P1. Congregate the appropriate technical and admirative team as per the identified requirements. P2. Communicate the Standards and requirements to the team members. P3. Arrange the facilities of team member's Capacity development and training. P4. Organize all obligatory facilities in lab, Equipment, storage area and Calibration of equipment as per the required standards. P5. Provide guidance to the subordinates to obtain desired outcome P6. Cooperate with team members to negotiate and achieve agreed outcomes, timelines and priorities P7. Recognise personal abilities and limitations when undertaking team tasks P8. Confirm personal role and responsibility within the team for particular outputs P9. Recognise the sensitivity to the diversity of other team members' backgrounds and beliefs



CU3. Plan work activities to achieve desired results	P1. Clarify allocated work targets and timelines set by superiors. P2. Prepare Break down work of activities into small achievable components and efficient sequences P3. list and arrange required resources prior to commencement of work P4. Identify the areas of work which could result in a delay of work, wastage of material or damage to tools. P5. Allocate appropriate responsibility to appropriate team member to avoid conflicts. P6. Review work plan in response to new information, urgent requests, changed situations or instructions from appropriate personnel P7. plan housekeeping activities prior to and post completion of work
CU4. Organize work to meet the expected outcome.	P1. select and check the working conditions of required tools and equipment for completion of desired work. P2. Follow prescribed and routine work-related sequences & procedures. P3. Use resources in an optimum manner to avoid any unnecessary wastage P4. Record completion of activities to confirm outputs in accordance with plan. P5. Seek assistance from relevant personnel when difficulties cannot be handled
CU5. Maintain the Lab documents.	P1. Record data and observations in the specific lab sheet/document. P2. Prepare the technical/administrative records and test reports in the specified lab format/sheets in accordance with workplace procedures. P3. Perform coding of lab sheets/document. P4. Maintain the confidentiality of lab document in accordance with lab policy.

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K-1. Explain the Quality



- K-2.** Explain the Scope of work of Laboratory
- K-3.** Define the ISO, Quality Standards
- K-4.** Explain the Quality objectives
- K-5.** Formulate Policies, procedures and work targets set by superiors
- K-6.** Assign Roles and responsibilities in executing the work for subordinates and self
- K-7.** Explain Standard practices of work to be adopted for assigned task
- K-8.** Explain the usage of available resources in a judicious and appropriate manner to minimize wastages or damage
- K-9.** Explain the Importance of effective communication and establishing strong working relationships with co-workers.
- K-10.** Access and Explain the Effects in case of failure relating to quality, timelines, safety, risks at the construction project site
- K-11.** Explain the Importance and need of supporting co-workers facing problems for smooth functioning of work
- K-12.** Explain the laboratory's business goals, key performance indicators (KPIs), organizational structure, delegations and responsibilities
- K-13.** Develop Standard operating procedures (SOPs) relevant to the laboratory's operations and scope of testing

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- decide on what sequence is to be adopted for execution of work
- plan and organize the materials, tools, tackles and equipment required to execute the work
- analyze areas of work which could result in a delay of work, wastage of material or damage to tools and tackles
- evaluate potential solutions to minimize avoidable delays and wastages at the construction site



11.21.2 Implement laboratory quality control procedures.

Overview: This competency standard covers the skills and knowledge required to implement quality control procedures in a testing laboratory by ensuring the quality and integrity of their own work, maintaining the quality control documents, detecting non-conformances and monitoring the reliability and validity of test results in compliance with the formulated quality control protocol.

Competency Units	Performance Criteria
CU1. Satisfy quality control requirements in daily lab work	P1. Ensure right test sample is selected for testing as per tagging/coding/numbering. P2. Ensure instrument, equipment used for tests are calibrated as per schedule of calibration. P3. Ensure all tools, apparatus, instrument and equipment are available in the laboratory and are in proper working condition. P4. Ensure test instrument attachments & gauges are adjusted and loads & load pausing are applied for required test as per manufacturer's guideline conforming to the standards for testing. P5. Ensure dial readings are recorded in a test register as shown by the test instruments in standard test Performa. P6. Ensure extracted test sample of soil and bitumen, concrete cubes casted in field are transferred undisturbed to site laboratory. P7. Carry out inspection and checking for all quality related procedures in the site and ensures activity at site are as per approved method statement and inspection test plan. P8. Conduct work in accordance with sustainable work practices. P9. Promote sustainability principles and standard work practices to other workers.
CU2. Maintain quality control documents as per Quality Management System	P1. Follow standard procedure for maintenance of Quality Control documents in laboratory. P2. Provide suitable codes and title to the documents file as per the site quality plan of documentation. P3. Maintain Quality Control documents such as method statements, standard testing procedures, site quality plans, site inspection checklist, sample register, test results, test



	certificates, inspection requests, non-compliance report and site instruction/observations etc. P4. Maintain document related to test equipment manual, ISO quality manual and equipment calibration reports etc. P5. Maintain current records providing factual evidence that required quality control activities and/or tests have been performed
CU3. Monitor the reliability & validity of tests results.	P1. Record quality control data in accordance with quality system. P2. Select monitoring methods appropriate for the type and volume of the work undertaken. P3. Detect the trends in testing activities by use of quality control procedures, such as: control charts, analyzing certified reference materials & repeatability from replicate tests etc. P4. Apply statistical techniques to determine data acceptability. P5. Identify potential causes for unacceptable results and nonconformities. P6. Suggest necessary actions to correct the problem and prevent incorrect results from being reported.

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain the difference between Quality assurance and Quality Control.
- K2.** Describe the first step in quality control.
- K3.** Describe concept and method of maintenance of register, documentation of method statements, quality plans inspection checklist, test report, bad workmanship in site
- K4.** Describe standard method for tagging/coding/numbering on test sample
- K5.** Explain standard method for sampling and different types of field test for construction materials
- K6.** Explain standard time periods for periodical calibration and maintenance of tools/equipment/machinery
- K7.** Describe the implementation plan of the formulated quality control protocol.
- K8.** Describe the meaning of reliability and validity of test.
- K9.** Identify the acceptance criteria for determining the validity of test results.



K10. Describe the Outline of statistical techniques for analyzing quality control data.

K11. Describe the procedure of accreditation and regulatory requirements relating to quality objectives

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Implement quality control procedures by selecting monitoring methods appropriate for the type and volume of the work undertaken.
- Collect and analyses all necessary data / documentation / records in quality control to identify unacceptable results and nonconformities.
- Implement actions to improve performance, working individually or as part of a team.

TOOLS AND EQUIPMENT'S

9. Pencil,
10. Eraser,
11. Sharpner,
12. Calculator



11.21.3 Analyze data and report results

Overview: This competency standard covers the skills and knowledge required to perform scientific calculations, analyse trends and uncertainty in data and report results within the required timeframe.

Competency Units	Performance Criteria
CU1. Perform scientific calculations	P1. Ensure test data are consistent with expectations and reasonable ranges P2. Calculate scientific quantities involving algebraic, power, exponential and/or logarithmic functions P3. Ensure calculated quantities are consistent with estimations P4. Present results using the appropriate units, uncertainties and number of significant figures
CU2. Analyze trends and relationships in data	P1. Determine linear and non-linear relationships between sets of data P2. Prepare control charts to determine if a process is in control. P3. Identify possible causes for out-of-control condition P4. Interpret the trends of test results by examining the control charts.
CU3. Determine variation and/or uncertainty in data distributions	P1. Organise raw data into appropriate frequency distributions. P2. Calculate means, medians, modes, ranges and standard deviations for ungrouped and grouped data. P3. Interpret frequency distributions to determine the characteristics of the data. P4. Calculate standard deviations and confidence limits for means and replicates. P5. Estimate the uncertainty in measurements using statistical analysis.
CU4. Assess the quality of data/results	P1. Analyse data trends and results for blanks, duplicates and/or check samples to detect systematic uncertainties P2. Determine data acceptability using statistical tests and documented procedures. P3. Check that estimations of uncertainties are reasonable and consistent with test method & specification requirements



	P4. Identify results that cannot be reconciled with technical records/normal ranges.. P5. Identify results that cannot be reconciled with sample, sample documentation and testing procedures. P6. Conclude valid test results by exercising appropriate judgment and evaluate the compliance of results against test standards, test methods or specifications.
CU5. Report results	P1 Use charts, tables and graphs to present results in the required format P2 Verify that entry of data and results are correct P3 Prepare reports and records in a format and style consistent with their intended use and workplace guidelines. P4 Communicate results within the specified time and in accordance with workplace confidentiality and security guidelines.

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Describe relevant scientific and technical terminology of data and observations to be interpreted.
- K2.** Describe principles, application and mathematical equations of statistical calculations such as mean, median, mode, range, variance, standard deviation, measures of central tendency, dispersion, frequency and probability.
- K3.** Explain pareto diagram
- K4.** Explain process flow diagram
- K5.** Explain Cause and effect diagram
- K6.** Explain Check sheets
- K7.** Explain Scatter diagram
- K8.** Explain Histogram
- K9.** Explain Normal Curve, Upper Control limit, Lower Control Limit.
- K10.** Explain central deviation and central deviation formula
- K11.** Explain and use graphical analysis of laboratory data;
- K12.** Preparation and interpretation of linear, semi-log and log-log graphs



- K13.** Determination of linear, logarithmic, exponential and power relationships
- K14.** Regression lines and interpretation of correlation coefficients
- K15.** Preparation of frequency distributions for given data
- K16.** Preparation of complex control charts.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- preparation and interpretation of linear, semi-log and log-log graphs
- determination of linear, logarithmic, exponential and power relationships
- preparation of frequency distributions for given data
- Interpret test results and observations independently according to appropriate criteria,
- Interpret the trends of test results by examining the control charts,
- Conclude test results by exercising appropriate Interpret the trends of test results by examining the control charts judgment and evaluate the compliance of test results against relevant specifications of test standards.

TOOLS AND EQUIPMENT'S

1. Pencil,
2. Eraser,
3. Sharpner,
4. Calculator



11.21.4 Apply quality system and continuous improvement processes

Overview: This competency standard covers the skills and knowledge required to satisfy quality system requirements in daily work analyze opportunities for corrective and/or optimization action, recommend corrective and/or optimization actions, participate in the implementation of recommended actions and participate in the development of continuous improvement strategies

Competency Units	Performance Criteria
CU1. Satisfy quality system requirements in daily work	P1. Access information on quality system requirements for own job function P2. Record and report quality control data in accordance with quality system P3. Follow quality control procedures to ensure products or data are of a defined quality as an aid to acceptance or rejection P4. Recognize and report non-conformances or problems P5. Conduct work in accordance with sustainable work practices P6. Promote sustainability principles and work practices to other workers
CU2. Analyse opportunities for corrective and/or optimisation action	P1. Compare current work practices, procedures and process or equipment performance with requirements and/or historical data or records P2. Recognise variances that indicate abnormal or sub-optimal performance P3. Collect and/or evaluate batch and/or historical records to determine possible causes for sub-optimal performance P4. Use appropriate quality improvement techniques to rank the probabilities of possible causes
CU3. Recommend corrective and/or optimisation actions	P1. Analyse causes to predict likely impacts of changes and decide on the appropriate actions P2. Identify required changes to standards and procedures and training P3. Report recommendations to designated personnel
CU4. Participate in the implementation of recommended actions	P1. Implement approved actions and monitor performance following changes to evaluate results P2. Implement changes to systems and procedures to eliminate possible causes



	P3. Document outcomes of actions and communicate them to relevant personnel
CU5. Participate in the development of continuous improvement strategies	P1. Review all relevant features of work practice to identify possible contributing factors leading to sub-optimal performance P2. Identify options for removing or controlling the risk of sub-optimal performance P3. Assess the adequacy of current controls, quality methods and systems P4. Identify opportunities to continuously improve performance P5. Develop recommendations for continual improvements of work practices, methods, procedures and equipment effectiveness P6. Consult with appropriate personnel to refine recommendations before implementation of approved continuous improvement strategies P7. Document outcomes of continuous improvement strategies and communicate them to relevant personnel

Knowledge & Understanding.

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1** Explain the Quality PDCA Cycle diagram. (Plan, Do, Check and Act).
- K2** Explain Process improvement
- K3** Describe, how systems and procedures support continuous improvement
- K4** Describe Adaptability of the improved process
- K5** Explain the principles of continuous improvement
- K6** Explain the method to implement continuous improvement
- K7** State the example of process improvement
- K8** Describe the difference between process improvement and continuous improvement?
- K9** Explain the Importance of staff involvement and training to sustain the process
- K10** Identify external opportunity and threats and setting the bench mark to improve the internal process.
- K11** Explain the importance of senior leadership engagement and support to improve the Process
- K12** Explain Oral communication skills to interact effectively with others.
- K13** Describe Language skills, Literacy skills, Numeracy skills
- K14** Explain Basics of statistics



- K15** State the importance of Employment skills enhancement that are essential to performance.
- K16** Explain Knowledge related to performance criteria.
- K17** Explain fish bone diagram to assess problem statement.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Apply quality system and continuous improvement processes
- Find out problem statement of a lab by using fish bone diagram and gap analysis of the problem statement.
- Perform activity PDCA of a specific problem of a lab to improve the quality.
- Compare current work practices, procedures and process or equipment performance with requirements and/or historical data or records. Recognise variances that indicate abnormal or sub-optimal performance.
- Analyse a quality situation and to apply corrective actions to optimise procedures of lab.

TOOLS AND EQUIPMENT'S

Pencil

Calculator

paper



11.22. Inspection and Testing of Concrete Structures

11.22.1 Perform NDT by rebound hammer and Rebar Detector tests

Overview: This competency standard covers the skills and knowledge required to perform non-destructive test by rebound hammer and Perform Rebar Detector test (NDT) for steel reinforcement, observing standards and health and safety measures.

Competency Units	Performance Criteria
CU-1 Carry out initial preparatory activities.	P1 Interpret test request to confirm samples to be tested, the test method and equipment involved P2 Identify hazards associates with the sample preparation, test methods, reagents and equipment. P3 Collect required equipment and materials P4 Identify faulty or unsafe components and equipment and report to appropriate personnel P5 Check calibration status of instruments and report any out-of-calibration items to appropriate personnel. P6 Plan task sequences for optimum efficiency
CU-2 Perform non-destructive test by rebound hammer	P1. Calibrate rebound hammer. P2. Select smooth, clean and dry surface rub off the rough surface. P3. Locate the points of observation. (The point of impact should be at least 20 mm away from any edge or shape discontinuity.) P4. Set Rebound Hammer vertical to the surface. Conduct the test horizontally on vertical surfaces or vertically upwards or downwards on horizontal surfaces. P5. Push hammer on surface. P6. Release the hammer and record the rebound number. Take six readings of rebound indices at each point of observation, P7. Find the compressive strength from graph.
CU-3 Perform Rebar Detector test (NDT) for steel reinforcement	P1. Select apparatus. P2. Operate the instrument on required surface. P3. Detect the steel its spacing and position.
CU-4 Maintain a safe work and environments	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material



	P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage
--	--

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain the factor influencing concrete properties
- K2.** Describe non-destructive tests
- K3.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction.
- K4.** Explain rebound number and its relation of strength
- K5.** Explain procedure of rebound hammer test
- K6.** Explain procedure and precaution in rebar detector
- K7.** Define concrete reinforcement
- K8.** Explain typical reinforcement of beam, columns and slab

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Balancing the rebound hammer vertical to surface
- Moving the rebar detector on the surface
- Adjusting transducers on surface of concrete
- Operating the machine to pull out
- Measure diameter of bar
- Moving the probe on the surface
- Observation of reading
- Interpretation of reading
- Storing of tools and equipment at appropriate place



List of Machines and Tools	
Sr. #	Description
1.	Rebound hammer.
2.	Rebar locator
4.	Inserts
5.	Spatula
6.	Measurement tape
7.	G. I. Tray
8.	File set
11.	Steel probe
12.	Measuring unit
14.	Wrench set
15.	Hammer set
16.	Screw driver set
17.	Plumb bob
18.	Adjustable Wrench
19.	Safety glasses
20.	Trowel
21.	Wheel barrow

List of Consumables	
Sr. #	Description
1.	Lubricating oil
2.	Cloths
3.	Grease
4.	Sand Paper
5.	Brushes
6.	Nuts and Bolts.
7.	Concrete samples

List of Personal Protective Equipment	
Sr. No	Description



1.	First Aid Box
2.	Fire Blanket
3.	Fire Bucket
4.	Safety Gloves
5.	Ear Protector
6.	Safety Goggles
7.	Safety Helmet
8.	Safety Mask
9.	Safety Shoes
10.	Safety Belt
11.	Sanitizer
12.	Formal Uniform for Work

List of Stationary

Sr. #	Description
1.	Handbooks / white papers / white charts
2.	File cover and files
3.	Pencils with color pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter & Seizers
7.	White board with white board markers
8.	Multimedia



11.22.2 Perform Ultrasonic pulse velocity and Penetration Tests (Windsor Probe)

Overview: This competency standard covers the skills and knowledge required to perform non-destructive test by Ultrasonic pulse velocity, Penetration Test (Windsor Probe), observing standards and health and safety measures.

Competency Units	Performance Criteria
CU-1 Carry out initial preparatory activities.	P1. Interpret test request to confirm samples to be tested, the test method and equipment involved P2. Identify hazards associates with the sample preparation, test methods, reagents and equipment. P3. Collect required equipment and materials P4. Identify faulty or unsafe components and equipment and report to appropriate personnel P5. Check calibration status of instruments and report any out-of-calibration items to appropriate personnel. P6. Plan task sequences for optimum efficiency
CU-2 Perform Ultrasonic pulse velocity	P1. Select apparatus. P2. Determine the most suitable test points on the material to be tested, make careful measurement of the path length 'L'. P3. Apply coolant to the surfaces of the transducers and press it hard onto the surface of the material. P4. Take the reading and do not move the transducers while a reading is being taken. (Continue holding the transducers onto the surface of the material until a consistent reading appears on the display) P5. Calculate pulse velocity through formula. P6. Interpret results to check quality of concrete
CU-3 Perform Penetration Test (Windsor Probe)	P1. Select the surface for test P2. Load the driver with a power load and probe suited for the type of concrete being examined. P3. Place the driver firmly on the actuating template and fire P4. Use locating template to locate the probes P5. Take three measurements P6. Compute the results



CU-4 Maintain a safe work and environments	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage
---	--

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain the factor influencing concrete properties
- K2.** Describe non-destructive tests
- K3.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction.
- K4.** Explain concrete reinforcement
- K5.** Define windser probe
- K6.** Explain the test procedure of Windsor probe
- K7.** Explain the mechanism of ultrasonic pulse velocity
- K8.** Explain typical reinforcement of beam, columns and slab

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Adjusting transducers on surface of concrete
- Operating the machine to pull out
- Measure diameter of bar
- Moving the probe on the surface
- Observation of reading
- Interpretation of reading
- Storing of tools and equipment at appropriate place



List of Machines and Tools	
Sr. #	Description
4.	Inserts
5.	Spatula
6.	Measurement tape
7.	G. I. Tray
8.	File set
9.	Ultrasonic pulse velocity tester
10.	Windser probe
11.	Steel probe
12.	Measuring unit
14.	Wrench set
15.	Hammer set
16.	Screw driver set
17.	Plumb bob
18.	Adjustable Wrench
19.	Safety glasses
20.	Trowel
21.	Wheel barrow

List of Consumables	
Sr. #	Description
1.	Lubricating oil
2.	Cloths
3.	Grease
4.	Sand Paper
5.	Brushes
6.	Nuts and Bolts.
7.	Concrete samples



List of Personal Protective Equipment	
Sr. No	Description
1.	First Aid Box
2.	Fire Blanket
3.	Fire Bucket
4.	Safety Gloves
5.	Ear Protector
6.	Safety Goggles
7.	Safety Helmet
8.	Safety Mask
9.	Safety Shoes
10.	Safety Belt
11.	Sanitizer
12.	Formal Uniform for Work

List of Stationary	
Sr. #	Description
1.	Handbooks / white papers / white charts
2.	File cover and files
3.	Pencils with color pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter & Seizers
7.	White board with white board markers
8.	Multimedia



11.22.3 Perform NDT Pull out Test and Profometer test

Overview: This competency standard covers the skills and knowledge required to perform non-destructive test by Pull out Test, and Profometer test observing standards and health and safety measures.

Competency Units	Performance Criteria
CU-1 Carry out initial preparatory activities.	P1. Interpret test request to confirm samples to be tested, the test method and equipment involved P2. Identify hazards associates with the sample preparation, test methods, reagents and equipment. P3. Collect required equipment and materials P4. Identify faulty or unsafe components and equipment and report to appropriate personnel P5. Check calibration status of instruments and report any out-of-calibration items to appropriate personnel. P6. Plan task sequences for optimum efficiency
CU-2 Preform Pull out Test	P1. Select apparatus. P2. Select the surface for test P3. Fix the apparatus on the surface with inserts in it.(the inserts may be cast in place or drilled in groove) P4. Apply force of hydraulic jack to pull out embedded insert. P5. Perform four pull out test in each location. P6. Calculate the tensile strength. P7. Compute the compressive strength
CU-3. Perform Profometer test	P1. Select specimen P2. Select the testing equipment and accessories P3. Adjust the profometer tester P4. Determine steel bar location P5. Move the tester cables on the concrete surface for scanning of rebars measuring the spacing P6. Measure bar diameter P7. Find the location of the rebar P8. Place the diameter probe on the bar parallel to the bar axis P9. Calculate the diameter of the bar by taking mean of four readings



	P10. Determine concrete cover P11. Use depth probe of the profometer to measure the cover P12. Place the depth probe above rebar P13. Observe the audio signal P14. Measure the concrete cover stored in memory
CU-4 Maintain a safe work and environments	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain the factor influencing concrete properties
- K2.** Describe non-destructive tests
- K3.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction.
- K4.** Explain Methods to put inserts for pull out test
- K5.** Explain the Use of hydraulic jack
- K6.** State concrete reinforcement
- K7.** Explain the procedure for pull out test
- K8.** Explain Profometer test procedure
- K9.** Explain typical reinforcement of beam, columns and slab

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Adjusting transducers on surface of concrete



- Fixing the hydraulic jack over the surface
- Operating the machine to pull out
- Measure diameter of bar
- Moving the probe on the surface
- Observation of reading
- Interpretation of reading
- Storing of tools and equipment at appropriate place

List of Machines and Tools	
Sr. #	Description
1.	Hydraulic jack
2.	Inserts
3.	Spatula
4.	Measurement tape
5.	Pull out apparatus
6.	File set
7.	Wrench set
8.	Hammer set
9.	Screw driver set
10.	Plumb bob
11.	Adjustable Wrench
12.	Thread/ rope
13.	Trowel
14.	Colour marker/ chalk

List of Consumables	
Sr. #	Description
1.	Lubricating oil
2.	Cloths
3.	Grease
4.	Sand Paper
5.	Brushes



6.	Nuts and Bolts.
7.	Concrete samples

List of Personal Protective Equipment

Sr. No	Description
1.	First Aid Box
2.	Fire Blanket
3.	Fire Bucket
4.	Safety Gloves
5.	Ear Protector
6.	Safety Goggles
7.	Safety Helmet
8.	Safety Mask
9.	Safety Shoes
10.	Safety Belt
11.	Sanitizer
12.	Formal Uniform for Work

List of Stationary

Sr. #	Description
1.	Handbooks / white papers / white charts
2.	File cover and files
3.	Pencils with color pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter & Seizers
7.	White board with white board markers
8.	Multimedia



11.22.4 Perform rebound hammer test and Rebar Detector test (NDT) for RCC Bridge

Overview: This competency standard covers the skills and knowledge required to perform non-destructive tests for concrete bridges.

Competency Units	Performance Criteria
CU1. Carry out initial preparatory activities.	P1 Access relevant job instructions from laboratory information management system (LIMS) P2 Interpret test request to confirm samples to be tested, the test method and equipment involved P3 Identify hazards to take sample P4 Prepare and workplace for task P5 Assemble / collect all required equipment and materials P6 Plan task / work sequences for optimum efficiency Identify the job, consult with the client and obtain relevant information, including the level of supervision required, drawings and specifications
CU-2 Perform rebound hammer test	P1 Calibrate rebound hammer. P2 Select smooth, clean and dry surface. P3 Rub off the rough surface. P4 Locate the points of observation. (The point of impact should be at least 20 mm away from any edge or shape discontinuity.) P5 Set Rebound Hammer vertical to the surface. Conduct the test horizontally on vertical surfaces or vertically upwards or downwards on horizontal surfaces. P6 Push hammer on surface. P7 Release the hammer and record the rebound number. Take six readings of rebound indices at each point of observation, P8 Find the Compressive strength from graph.
CU-3 Perform Rebar Detector test (NDT) for steel reinforcement	P1 Identify the apparatus. P2 Operate the instrument on required bridge surface. P3 Detect the steel its spacing and position.
CU 4- Maintain a safe work environment	P1 Use PPEs and apply safe work practices P2 Rehabilitate sampling site and Minimize generation of wastes P3 Collect waste material P4 Dispose waste Material in accordance with environmental /



	quarantine requirements and workplace procedures P5 Clean the equipment P6 Check serviceability of equipment before storage
--	---

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K-1.** Explain the types of bridges.
- K-2.** Describe the bridge elements
- K-3.** Explain the factor influencing concrete properties
- K-4.** Describe non-destructive tests
- K-5.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction.
- K-6.** Define compressive strength
- K-7.** Enlist procedure for rebound hammer test
- K-8.** Explain the procedure of rebar detector test
- K-9.** Explain the relation between rebound number and strength
- K-10.** Explain typical reinforcement of column, beam and slab
- K-11.** Enlist difference between rebound hammer test and rebar detector test

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Balancing the rebound hammer vertical to surface
- Moving the rebar detector on the surface
- Adjusting transducers on surface of concrete
- Fixing the hydraulic jack over the surface
- Operating the machine to pull out
 - Measure diameter of bar
 - Moving the probe on the surface
 - Observation of reading



- Interpretation of reading
- Storing of tools and equipment at appropriate place

LIST OF TOOLS AND EQUIPMENT

List of Machines and Tools	
Sr. #	Description
1.	Rebound hammer.
2.	Rebar locator
3.	Measurement tape
4.	G. I. Tray
5.	File set
6.	Plumb bob
7.	Adjustable Wrench
8.	Colour markers / chalk
9.	Trowel
10.	Thread /rope

List of Consumables	
Sr. #	Description
1.	pipes
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts

List of Personal Protective Equipment	
Sr. #	Description
1.	First aid box
2.	Fire extinguisher



3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers

List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.5 Perform Ultrasonic pulse velocity test and Penetration test by Windsor probe for concrete Bridge

Overview: This competency standard covers the skills and knowledge required to perform non-destructive tests for concrete bridges.

Competency Units	Performance Criteria
CU1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency Identify the job, consult with the client and obtain relevant information, including the level of supervision required, drawings and specifications
CU-2 Perform Ultrasonic pulse velocity test	P1 Identify apparatus. P2 Calibrate the ultrasonic pulse velocity tester. P3 Determine the most suitable test points on the bridge to be tested, make careful measurement of the path length 'L'. P4 Apply couplant to the surfaces of the transducers and press it hard onto the surface of the bridge. P5 Take the reading and Do not move the transducers while a reading is being taken. (Continue holding the transducers onto the surface of the material until a consistent reading appears on the display) P6 Calculate pulse velocity through formula. P7 Interpret results to check quality of concrete
CU-3 Perform Penetration test by Windsor probe	P1 Select the observation points on bridges. P2 Load the driver with a power load and probe suited for the type of concrete being examined. P3 Place the driver firmly on the actuating template and fire P4 Use locating template to locate the probes P5 Take three measurements P6 Compute the results



CU 4- Maintain a safe work environment	P1 Use PPEs and apply safe work practices P2 Rehabilitate sampling site and Minimize generation of wastes P3 Collect waste material P4 Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5 Clean the equipment P6 Check serviceability of equipment before storage
---	---

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K-1.** Explain the types of bridges.
- K-2.** Describe the bridge elements
- K-3.** Explain the factor influencing concrete properties
- K-4.** Describe non-destructive tests
- K-5.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction
- K-6.** Describe ultrasonic pulse velocity meter and test procedure.
- K-7.** Describe penetration test by Windsor method
- K-8.** Describe penetration
- K-9.** Explain the role of transducer in ultrasonic pulse velocity test

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Balancing the rebound hammer vertical to surface
- Moving the rebar detector on the surface
- Adjusting transducers on surface of concrete
- Fixing the hydraulic jack over the surface
- Operating the machine to pull out
- Measure diameter of bar



- Moving the probe on the surface
- Observation of reading
- Interpretation of reading
- Storing of tools and equipment at appropriate place

LIST OF TOOLS AND EQUIPMENT

List of Machines and Tools	
Sr. #	Description
1	File set
2	Ultrasonic pulse velocity tester (Electrical pulse generator, Transducer – one pair , Amplifier, Electronic timing device)
3	Windser probe
4	Wrench set
5	Hammer set
6	Screw driver set
7	Plumb bob
8	Adjustable Wrench
9	Safety glasses
10	Trowel
11	Wheel barrow

List of Consumables	
Sr. #	Description
1.	pipes
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts

List of Personal Protective Equipment	
Sr. #	Description



1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers

List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.6 Perform Pull out test and Profometer test on RCC Bridge

Overview: This competency standard covers the skills and knowledge required to perform non-destructive tests for rebar location in RCC bridges.

Competency Units	Performance Criteria
CU1. Carry out initial preparatory activities.	P1 Access relevant job instructions from laboratory information management system (LIMS) P2 Interpret test request to confirm samples to be tested, the test method and equipment involved P3 Identify hazards to take sample P4 Prepare and workplace for task P5 Assemble / collect all required equipment and materials P6 Plan task / work sequences for optimum efficiency Identify the job, consult with the client and obtain relevant information, including the level of supervision required, drawings and specifications
CU-2 Perform Pull out test	P1 Identify apparatus. P2 Select the observation points on bridges. P3 Fix the apparatus on the bridge surface with inserts in it.(the inserts may be cast in place or drilled in groove) P4 Apply force of hydraulic jack to pull out embedded insert. P5 Perform four pull out test in each location. P6 Calculate the tensile strength. P7 Compute the compressive strength
CU3. Perform Profometer test for rebar location	P1. Identify the observation points on bridges. P2. Identify the tester P3. Adjust the profometer tester P4. Move the tester cables on the concrete surface for scanning of rebars measuring the spacing P5. Find the location of the rebar P6. Place the diameter probe on the bar parallel to the bar axis P7. Calculate the diameter of the bar by taking mean of four readings P8. Use depth probe of the profometer to measure the cover P9. Place the depth probe above rebar P10. Observe the audio signal P11. Measure the concrete cover stored in memory



CU 4- Maintain a safe work environment	P1 Use PPEs and apply safe work practices P2 Rehabilitate sampling site and Minimize generation of wastes P3 Collect waste material P4 Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5 Clean the equipment P6 Check serviceability of equipment before storage
---	---

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1.** Explain the types of bridges.
- K2.** Describe the bridge elements
- K3.** Explain the factor influencing concrete properties
- K4.** Describe non-destructive tests
- K5.** Explain different methods of mix design, transportation of fresh concrete it's placing and compaction.
- K6.** State Methods to put inserts for pull out test
- K7.** Explain Use of hydraulic jack
- K8.** Explain concrete reinforcement in column, beam and slabs
- K9.** Explain to Profometer test procedure
- K10.** Explain pull out test procedure

Critical evidence

The candidate needs to produce following critical evidence in order to competent in this competency standard:

- Identify tools and equipment
- Check physical condition of tools and equipment before use
- Perform maintenance as per standards
- Calibrate the measuring tools
- Balancing the rebound hammer vertical to surface
- Moving the rebar detector on the surface
- Adjusting transducers on surface of concrete
- Fixing the hydraulic jack over the surface



- Operating the machine to pull out
 - Measure diameter of bar
 - Moving the probe on the surface
 - Observation of reading
 - Interpretation of reading
 - Storing of tools and equipment at appropriate place

LIST OF TOOLS AND EQUIPMENT

List of Machines and Tools	
Sr. #	Description
1.	Hydraulic jack
2.	Inserts
3.	Spatula
4.	Measurement tape
5.	File set
6.	Profometer tester
7.	Wrench set
8.	Hammer set
9.	Screw driver set
10	Plumb bob
11	Adjustable Wrench
12	Trowel
13	Wheel barrow

List of Consumables	
Sr. #	Description
1.	pipes
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts



List of Personal Protective Equipment

Sr. #	Description
1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers

List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.7 Perform Flat Jack Test and Impulse Radar Test

Overview: This competency standard covers the skills and knowledge required to perform Non-Destructive tests for masonry bridges.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform Flat Jack Test	P1. Identify the bridge P2. Select observatory areas P3. Identify the testing machine P4. Release stress in a small area of a structure by a plane cut perpendicular to its surface. P5. Load the flat jack in the cut P6. Increase the pressure gradually by hydraulic pump P7. Note the state of strain equal to the previous existing condition before the cut. P8. Measure the reference points, glued about the cut, taken at various pressures P9. Increase the pressure in increments. P10. Observe the point of non-linearity in the load- strain curve to avoid damage in the structure.
CU-3. Perform Impulse Radar Test	P1. Identify the inspection areas of the structure P2. Operate the impulse radar P3. Adjust the antenna of the tester on the surface so that electromagnetic half-sine wave is pulsed P4. Observe the pulse on a separate receiving antenna P5. Record the data P6. Plot an analogue time domain trace



	P7. Observe the analogue signal displayed on a VDU meter
CU-4 Maintain a safe work environment	P-1 Use PPEs and apply safe work practices P-2 Rehabilitate sampling site and Minimize generation of wastes P-3 Collect and/or dispose of all waste in accordance with environmental/quarantine requirements and workplace procedures P-4 Clean and care all equipment and check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1. Explain masonry bridges
- K2. Explain use of masonry bridges
- K3. State types of masonry bridges
- K4. Explain Elements of masonry bridges
- K5. Enlist Non-Destructive tests for masonry bridges
- K6. Explain Procedure for masonry bridges inspection.
- K7. Explain procedure of flat jack test
- K8 Explain procedure of impulse radar test

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Maintenance of tools and equipment
- Observe the surface of the bridge
- Adjustment of testers on the surface
- Placement of tools and equipment at appropriate place

TOOLS AND EQUIPMENT

List of Machines and Tools	
Sr. #	Description



1.	Flat Jack Test
2.	hydraulic pump
3.	Impulse Radar Test
4.	VDU meter

List of Consumables

Sr. #	Description
1.	Steel samples
2.	Water
3.	Brush
4.	Masonry samples
5.	Lubricating oil
6.	Water
7.	Cloths
8.	Nuts
9.	Bolts
10.	Concrete samples

List of Personal Protective Equipment

Sr. No	Description
1.	First Aid Box
2.	Fire Blanket
3.	Fire Bucket
4.	Safety Gloves
5.	Ear Protector
6.	Safety Goggles
7.	Safety Helmet
8.	Safety Mask
9.	Safety Shoes
10.	Safety Belt
11.	Sanitizer
12.	Formal Uniform for Work



List of Stationary	
Sr. #	Description
1.	Handbooks / white papers / white charts
2.	File cover and files
3.	Pencils with color pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter & Seizers
7.	White board with white board markers
8.	Multimedia



11.22.8 Perform Stress rupture Test and Creep Test on pipes

Overview: This competency standard covers the skills and knowledge required to identify the types of pipes, testing and leakage detection.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform Stress rupture Test	P1. Select specimen P2. Identify the testing machine P3. Adjust the specimen in the stress rupture testing machine P4. Operate the machine P5. Apply constant load on the specimen P6. Note down the temperature P7. Observe the time of rupture
CU-3. Perform Creep Test	P1. Adjust the specimen in the creep testing machine P2. Operate the machine P3. Apply constant load on the specimen below its yield stress P4. Measure the dimensional changes to the specimen P5. Use extensometer to measure the deformation P6. Determine the time at which the specimen will deform at a given load and temperature P7. Use the readings to extrapolate time-to-failure for longer time periods
CU-4. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5. Clean the equipment



	P6. Check serviceability of equipment before storage
--	---

Knowledge & Understanding

The candidate must be able to develop understanding to identify the types of pipes, testing and leakage detection and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1. Explain pipes
- K2. Explain different Properties of pipes
- K3. Enlist Name of test of pipes
- K4. Explain Procedure of pipes testing
- K5. Describe different Types of pipes
- K6. Describe Importance of pipes
- K7. Describe Measuring tools and techniques
- K8. Explain Properties of types of pipes
- K9. Explain Durability aspects of pipes
- K10. Enlist different type of pipes
- K11. Explain mechanical joints
- K12. State collar joints
- K13. Enlist the function of creep testing machine
- K14. Define yield stress
- K15. State extensometer use in creep test
- K16. Enlist the function of full notch creep test
- K17. Define lever arm in full notch creep test

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment
- Adjust for standard
- Load and temperature
- Put Pressure gradually
- Amount of water

List of Machines and Tools



Sr. #	Description
1.	Timer
2.	Measuring tape
3.	Safety glasses
4.	stress rupture testing machine
5.	creep testing machine
6.	File set

List of Consumables

Sr. #	Description
1.	pipes
2.	Water
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts

List of Personal Protective Equipment

Sr. #	Description
1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers



List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.9 Perform Full Notch Creep Test and Small-scale steady-state test

Overview: This competency standard covers the skills and knowledge required to identify the types of pipes, testing and leakage detection on pipes.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform Full Notch Creep Test	P1. Adjust the specimen in the full notch creep tester P2. Operate the tester P3. Apply constant stress on specimen via lever arm loading arrangement in a test fluid P4. Record the failing time of specimen P5. Assess the resistance to brittle or ductile failure of specimen P6. Draw a graph between stress and failure time
CU-3. Perform Small-scale steady-state test	P1. Adjust the specimen in the small-scale steady state tester P2. Operate the tester P3. Apply specified pressure along the longitudinal side of the specimen P4. Measure the temperature of the specimen P5. Examine the crack has appeared P6. Repeat the series of tests at different pressure but constant temperature P7. Repeat the series of tests at different temperature but constant pressure P8. Determine the critical pressure P9. Determine the critical temperature
CU-4. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material



	P4. Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage
--	---

Knowledge & Understanding

The candidate must be able to develop understanding to identify the types of pipes, testing and leakage detection and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1. Introduction to pipes
- K2. Explain different types of pipes w.r.t materials
- K3. Explain Properties of pipes
- K4. Explain Name of test of pipes
- K5. Explain Procedure of pipes testing
- K6. State Importance of pipes
- K7. Define Capacity of pipes
- K8. Explain Measuring tools and techniques
- K9. Describe Properties of types of pipes
- K10. Explain Durability aspects of pipes
- K11. Enlist different type of pipes
- K12. Explain mechanical joints
- K13. State collar joints

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment
- Adjust for standard
- Load and temperature
- Put Pressure gradually
- Amount of water

List of Machines and Tools

Sr. #	Description
-------	-------------



1.	Grade 40 PVC pipe samples
2.	Measuring tape
3.	Notch creep testing machine with arm , weights , bath and solution
4.	Steady state test apparatus
5.	File set

List of Consumables

Sr. #	Description
1.	pipes
2.	Water
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts

List of Personal Protective Equipment

Sr. #	Description
1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers



List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.10 Conduct Tensile Test, Compression Test and Leakage Detection Test

Overview: This competency standard covers the skills and knowledge required to identify the types of pipes, testing and leakage detection of pipes.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Conduct Tensile Test	P1. Identify UTM P2. Fix specimen in the apparatus P3. Apply load on the specimen until rupture P4. Check specific time P5. Observe the deformation/elongation of specimen P6. Repeat test as per standards P7. Take readings at yield point P8. Plot the graph P8. Record result according to SOP
CU-3. Conduct Compression Test	P1. Identify UTM P2. Fix specimen in the apparatus P3. Apply load on the specimen until rupture P4. Check specific time P5. Observe the deformation/compression of specimen P6. Repeat test as per standards P7. Take readings at yield point P8. Plot the graph P8. Record result according to SOP
CU 4- Perform Leakage Detection Test	P1. Identify the specimen P2. Identify leakage testing machine P3. Connect the displacement pump to the system along with pressure gauge



	P4. Measure the amount of water pumped P5. Close all other valves linked to the specimen P6. Fill the pipe with water P7. Remove all air in the specimen P8. Test the specimen by applying pressure for 2 hours P9. Measure the amount of water that is pumped out P10. Evaluate the amount of leakage P11. Compare the obtained amount to the maximum allowable leakage in AWWA standard
CU-5. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to develop understanding to identify the types of pipes, testing and leakage detection and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1. Enlist hazards for sampling for pipes testing
- K2. Enlist procedure for collecting required materials for pipes testing
- K3. Which testing machine is used for rupture of pipes
- K4. How to adjust specimen in compression testing machine
- K5. How much load is applied on specimen?
- K6. Enlist the function compression test
- K7. Define yield stress
- K8. Define compressive strength.
- K9. Define tensile strength
- K10. Explain procedure of tensile strength test.
- K11. Explain the test procedure of compression test.
- K12. Explain Durability aspects of different types of pipes
- K13. Durability of pipes



K14. Enlist the function of leakage detection test

K15. Enlist difference between compression and leakage detection test

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment
- Adjust for standard
- Load and temperature
- Put Pressure gradually
- Amount of water

List of Machines and Tools

Sr. #	Description
1.	Timer
2.	Measuring tape
3.	Safety glasses
5.	UTM
4.	Leakage detection tester
8.	File set
9.	Gloves
10.	Helmet

List of Consumables

Sr. #	Description
1.	pipes
2.	Water
3.	Cloths
4.	Brushes
5.	Nuts
6.	Bolts

List of Personal Protective Equipment



Sr. #	Description
1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes
12.	Safety Belt
13.	Sanitizers

List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.22.11 Conduct hydraulic pressure test and 3 edge bearing test on RCC pipes

Overview: This competency standard covers the skills and knowledge required to calculate the strength of RCC pipes and defects under pressure.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Conduct hydraulic pressure test	P1. Identify pump and pressure gauge. P2. Identify the pipe circuit. P3. Fill the circuit (slowly) with working fluid (water) at lowest location providing air release at highest point. P4. Connect the test pump to pressurize the line. P5. Pressure gauge is connected to the lowest possible point. P6. Calculate the pressure including all head pressure. P7. Releasing the Pressure of the pipe circuit P8. Pressurize the return and drain line with greater pressure. P9. Take three readings P10. Record result according to SOP
CU-3. Conduct 3 edge bearing Test	P1. Identify jacks. P2. Fix specimen in the apparatus P3. Apply load on the specimen until rupture P4. Check specific time P5. Observe the deformation (cracks) of specimen P6. Repeat test as per standards P7. Take readings at yield point P8. Plot the graph P8. Record result according to SOP
CU-4. Maintain a safe work environment	P1. Use PPEs and apply safe work practices



	P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental / quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage
--	---

Knowledge & Understanding

The candidate must be able to develop understanding to identify the types of pipes, testing and leakage detection and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- K1. Define rcc pipes.
- K2. Enlist procedure for collecting required materials for pipes testing
- K3. Explain the use of pressure gauge and pump.
- K4. Describe the adjustment of specimen in 3 edge bearing test.
- K5. State the defects in concrete.
- K6. Describe the precaution in hydraulic pressure test.
- K7. Define hydraulic pressure.
- K8. Explain the defects due to hydraulic pressure.
- K9. Enlist the test on rcc pipes.
- K10. Explain procedure of 3 edge bearing test.
- K11. Explain the test procedure of hydraulic pressure test.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment
- Adjust for standard
- Load and temperature
- Put Pressure gradually
- Amount of water

List of Machines and Tools

Sr. #	Description
-------	-------------



1	Rcc pipe samples
2	Measuring tape
3	Pressure gauge
4	Pressure pump
5	Jacks
6	File set
7	Wrench set

List of Consumables	
Sr. #	Description
1	Water
2	Cloths
3	Brushes
4	Nuts
5	Bolts

List of Personal Protective Equipment	
Sr. #	Description
1.	First aid box
2.	Fire extinguisher
3.	Fire Blanket
4.	Fire Bucket
5.	Safety Gloves
6.	Ear protector
7.	Safety goggles
8.	Safety Helmet
9.	Safety Masks
10.	Formal Uniform for Work
11.	Safety Shoes



12.	Safety Belt
13.	Sanitizers

List of Stationary

Sr. #	Description
1.	Handbooks
2.	File cover and files
3.	Pencils
4.	Rubber
5.	Sharpeners
6.	Paper Cutter
7.	Seizers
8.	Colors Pencil
9.	White charts
10.	Permanent markers
11.	White board markers



11.23. Inspection and Testing of Steel Structures

11.23.1 Perform Hardness Test on metals using Rockwell Method

Overview: This competency standard covers the skills and knowledge required find hardness of different metals i.e. Aluminum, copper, mild steel by using Rockwell Hardness test.

Competency Units	Performance Criteria
CU-1. Prepare sample to conduct hardness test of metallic plate.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required of given metallic plate. P4. Record the measurements of sample.
CU-2. Set up apparatus to conduct hardness test of metallic plate by Rockwell method.	P1. Identify Rockwell hardness test apparatus P2. Fix suitable indenter P3. Place specimen on the platform. P4. Raise the platform P5. Set position against the indenter
CU-3. Conduct hardness test of metallic plate by Rockwell method.	P1. Apply the load by loading lever and wait for specified time P2. Repeat the test as per standards.
CU-4. Record the test observations and evaluate result for Rockwell method.	P1. Record reading of pointer on the corresponding scale of the dial gauge. P2. Tabulate the readings. P3. Apply formula P4. Evaluate the result
CU-5. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.

Knowledge & Understanding



The candidate must be able to develop understanding to evaluate the hardness number of given metals using Rockwell hardness test and evaluate the rock well hardness number by rock well hardness test according to the standard procedure.

This includes the knowledge of:

- K1. Define Hardness?
- K2. Define Toughness and Brittleness?
- K3. Define ductility, Resilience and Flexural strength.
- K4. Explain Hardness tests?
- K5. Define and explain hardness number?
- K6. Define Static Indentation, Dynamic Indentation?

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform Rockwell hardness test



11.23.2 Perform Hardness Test on metals using Brinell Method

Overview: This competency standard covers the skills and knowledge required find hardness of different metals i.e. Aluminum, copper, mild steel by using Brinell's Hardness test and limitations of Brinell's hardness test.

Competency Units	Performance Criteria
CU-1. Prepare sample to conduct hardness test of metallic plate.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required of given metallic plate. P4. Record the measurements of sample.
CU-2. Set up apparatus to conduct hardness of metallic plate by Brinell method	P1. Identify Brinell's Hardness test apparatus P2. Fix suitable indenter P3. Place specimen on the platform. P4. Raise the platform P5. Set position against the indenter
CU-3. Conduct hardness test of metallic plate by Brinell method.	P1. Apply the load by loading lever and wait for specified time P2. Repeat the test as per standards.
CU-4. Record the test observations and evaluate result for Brinell method.	P1. Record reading of pointer on the corresponding scale of the dial gauge. P2. Tabulate the readings. P3. Apply formula P4. Evaluate the result
CU-5. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate the hardness number of given metals using Brinell hardness test.

This includes the knowledge of:



- K1. Define Hardness?
- K2. Define Toughness and Brittleness?
- K3. Define ductility, Resilience and Flexural strength.
- K4. Explain Hardness tests?
- K5. Define and explain hardness number?
- K6. Define Static Indentation, Dynamic Indentation?

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform Brinell's Hardness test



11.23.3 Conduct Impact test on metals

Overview: This competency standard covers the skills and knowledge required to evaluate the impact energy / Impact strength/ Toughness and bending of a given test metal. This test measures the notch toughness of material under shock loading. It is providing a good way of comparing toughness of various materials or toughness of same material under different conditions.

Competency Units	Performance Criteria
CU-1. Prepare sample to conduct Impact strength of steel.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required given metal specimen P4. Record the measurements of sample.
CU-2. Set up apparatus to conduct Impact strength of steel by Izod impact test.	P1. Identify impact test machine P2. Place specimen as per standard P3. Identify the striking edge P4. Set Striking hammer in safe test position. P5. Fix specimen in impact testing machine. P6. Set Indicator of machine to zero.
CU-3. Set up apparatus to conduct Impact strength of steel by Charpy impact test.	P1. Identify impact test machine P2. Place specimen as per standard P3. Identify the striking edge. P4. Set Striking hammer in safe test position. P5. Fix specimen in impact testing machine. P6. Set Indicator of machine to zero.
CU-4. Conduct Impact test of metals.	P1. Identify testing machine P2. Stop oscillations of machine P3. Check Release hammer position P4. Repeat procedure P5. Striking hammer to its idle position P6. Check result & record.
CU-5. Record the test observations and evaluate result of the Impact test of steel.	P1. Record reading on dial gauge. P2. Record Tabular form P3. Apply Formula P4. Evaluate Results



CU-6. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.
---	--

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate impact strength of steel (Total energy absorbed before fracture) and Modulus of Rupture (Bending) includes the knowledge of:

- K1.** Define and Explain Impact test.
- K2.** Define Impact Load and Impact Energy
- K3.** Explain Izod and Charpy specimen holder.
- K4.** Define toughness, ductility and brittleness
- K5.** Define deformation
- K6.** Define Bending moment, bending equation
- K7.** Define Neutral Axis
- K8.** Define Section Modulus
- K9.** Define Modulus of Rupture (bending)

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Observations and calculations statement showing toughness of the material.
- Calculation sheet for impact strength and impact energy.



11.23.4 Conduct bending test on metals

Overview: This competency standard covers the skills and knowledge required to evaluate the impact energy / Impact strength/ Toughness and bending of a given test metal. This test measures the notch toughness of material under shock loading. It is providing a good way of comparing toughness of various materials or toughness of same material under different conditions.

Competency Units	Performance Criteria
CU-1. Prepare sample to conduct Impact strength of steel.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required given metal specimen P4. Record the measurements of sample.
CU-2. Set up apparatus to conduct Bending test of mild steel bar & Young's modulus of elasticity	P1. Identify Universal testing machine P2. Fix dial gauge at zero P3. Fix Roller supports mounted on a rigid base. P4. Adjust roller support distance. P5. Fix bending tool with appropriate method P6. Fix a suitable span. P7. Set a proper range of loading P8. Check result & record.
CU-3. Conduct Bending test of mild steel bar & Young's modulus of elasticity	P1. Identify apparatus P2. Apply the load gradually up to failure P3. Check gauge P4. Apply formula P5. Evaluate Result
CU-4. Record the test observations and evaluate result of the Bending test of mild steel bar & Young's modulus of elasticity	P1. Identify apparatus P2. Record the Dial gauge reading. P3. Record Load at failure. P4. Apply formula P5. Evaluate Results
CU-5. Maintain safe work environment	P4. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P5. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P6. Clean and check serviceability of test equipment before



	storage.
--	----------

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate impact strength of steel (Total energy absorbed before fracture) and Modulus of Rupture (Bending) includes the knowledge of:

- K1.** Define toughness, ductility and brittleness
- K2.** Define deformation
- K3.** Define Bending moment, bending equation
- K4.** Define Neutral Axis
- K5.** Define Section Modulus
- K6.** Define Modulus of Rupture (bending)

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Observations and calculations statement showing Bending of the material.
- Calculation sheet for modulus of rupture (bending).



11.23.5 Conduct Tensile Test on Metals Using Young's Modulus Apparatus

Overview: This competency standard covers the skills and knowledge required to evaluate relation between stress and strain of a copper wire, evaluate Young's modulus of the material of the wire, determine tensile strength of mild steel and plot a graph between stress and strain of mild steel.

Competency Units	Performance Criteria
CU-1. Prepare sample to conduct Young's modulus test of metallic wire.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required of given metallic wire. P4. Record sample measurements.
CU-2. Set up apparatus to conduct Young's modulus test of metallic wire by young's modulus apparatus.	P1. Identify test apparatus P2. Fix suitable indenter P3. Fix specimen at apparatus.
CU-3. Conduct tensile test of wire by young's modulus method.	P1. Apply load at specimen. P2. Check specified time P3. Check elongation P4. Repeat the test as per standards.
CU-4. Record the test observations and evaluate result of the young's modulus test.	P1. Record pointer reading of the gauge scale. P2. Tabulate the readings. P3. Apply formula P4. Evaluate the result P5. Prepare graph P6. Record the result
CU-5. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate relation between stress and strain of a copper wire, evaluate Young's modulus of the material of the wire, determine tensile strength of mild steel and plot a graph between stress and strain of mild steel and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:



- K1.** Define and explain the terms stress, and its types (tensile, compressive and shear)
- K2.** Define and explain strain, its types (linear, lateral and volumetric) and poisson's ratio.
- K3.** Define and explain Hook's Law.
- K4.** State Young's modulus of elasticity, modulus of rigidity and bulk modulus.
- K5.** Explain mechanical properties of materials like elasticity, plasticity, ductility, brittleness and hardness, etc.
- K6.** Identify parts and attachments of U.T.M for tensile and compression tests. Also explain the salient points in stress strain curve for ductile material.
- K7.** Numerical problems relating to simple stress and strain.
- K8.** Numerical problems relating to Poisson's ratio and Hook's Law.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Observations and calculations statement showing relation between stress and strain of a copper / steel wire.
- Calculation sheet for Young's modulus of copper/steel wire.



11.23.6 Conduct Tensile Test on Metals Using UTM

Overview: This competency standard covers the skills and knowledge required to evaluate relation between stress and strain of a copper wire, evaluate Young's modulus of the material of the wire, determine tensile strength of mild steel and plot a graph between stress and strain of mild steel.

Competency Units	Performance Criteria
CU-1. Set up apparatus to conduct tensile test of steel bar by U.T.M.	P1. Identify U.T.M. P2. Fix zero on gauge. P3. Fix specimen at U.T.M.
CU-2. Conduct tensile test of steel bar by U.T.M.	P1. Apply load until rupture. P2. Check specified time P3. Check elongation P4. Repeat test as per standards P5. Take reading at yield point. P6. Record Result
CU-3. Record the test observations and evaluate result of the tensile test by U.T.M.	P1. Record reading on pointer. P2. Tabulate the readings. P3. Apply formula P4. Evaluate the result P5. Prepare graph P6. Record the result
CU-4. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate relation between stress and strain of a copper wire, evaluate Young's modulus of the material of the wire, determine tensile strength of mild steel and plot a graph between stress and strain of mild steel and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define and explain the terms stress, and its types (tensile, compressive and shear)



- K2.** Define and explain strain, its types (linear, lateral and volumetric) and poisson's ratio.
- K3.** Define and explain Hook's Law.
- K4.** State Young's modulus of elasticity, modulus of rigidity and bulk modulus.
- K5.** Explain mechanical properties of materials like elasticity, plasticity, ductility, brittleness and hardness, etc.
- K6.** Identify parts and attachments of U.T.M for tensile and compression tests. Also explain the salient points in stress strain curve for ductile material.
- K7.** Numerical problems relating to simple stress and strain.
- K8.** Numerical problems relating to Poisson's ratio and Hook's Law.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Observations and calculations statement showing tensile strength of mild steel by U.T.M.
- Graph sheet for stress and strain of mild steel by U.T.M.



11.23.7 Conduct Torsion Tests on metals

Overview: This competency standard covers the skills and knowledge required to Evaluate the behavior of Mild steel when subjected to a gradually increasing torsional load and to determine the rigidity modulus & modulus of rupture (torsion).

Competency Units	Performance Criteria
CU1. Prepare sample to conduct of modulus of rupture and modulus of rigidity.	P1. Identify material of metal sample. P2. Identify requirements of sample. P3. Prepare sample of required of given metallic bar P4. Record the measurements of sample.
CU2. Set up apparatus to conduct modulus of rigidity by torsion Test.	P1. Identify Torsion test apparatus along with angle of twist measuring attachment P2. Clamp the specimen in the jaws of machine. P3. Adjust the length of specimen by means of sliding spindle P4. Set the Appropriate range by capacity change lever P5. Set the maximum load pointer to zero
CU3. Conduct torsion test of Steel bar.	P1. Identify test apparatus P2. Apply load at suitable increments. P3. Calculate Load at failure P4. Evaluate result
CU4. Record the test observations and evaluate result of the Torsion test of steel.	P1. Record the load increments. P2. Evaluate twisting angle. P3. Plot torque vs. angle of twist. P4. Evaluate the result
CU5. Maintain safe work environment	P1. Use safe work procedures and personal protective equipment (PPE) to ensure personal safety and that of other personnel P2. Clean work area and collect, recycle or dispose of all waste in accordance with workplace procedures P3. Clean and check serviceability of test equipment before storage.

Knowledge & Understanding

The candidate must be able to develop understanding to evaluate the modulus of rigidity and modulus of rupture (torsion) and their relation. Determine the relation between Torsion and angle of twist. This includes the knowledge of:



- K1.** Define Torque
- K2.** Define Modulus of rigidity and Modulus of Rupture
- K3.** Find the value of G for different materials
- K4.** Define Angle of Twist
- K5.** Define Modulus of Rupture
- K6.** Define Polar Moment of Inertia
- K7.** Numerical problems related to torsion

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Observations and calculations statement showing relation between Torque and Angle of twist.
- Calculation by using formula for modulus of rigidity.
- Observations and calculations statement showing torque, angle of twist and modulus of rigidity.

Graph sheet for Torque and Angle of Twist.



11.23.8 Perform Radiographic and Ultrasonic Testing on Steel Bridges

Overview: This competency standard covers the skills and knowledge required to perform Strength test for steel bridges.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform radiographic testing on steel bridges	P1. Select observatory points P2. Examine carefully the specimen P3. Select thickness, density and wavelength of the material P4. Observe the images on identifying tube. P5. Observe the interpretation of radiograph P6. Observe the optimum time of exposure
CU-3. Perform ultrasonic testing through transmission technique	P1. Select observatory points P2. Examine carefully the specimen P3. Apply transmitter on one side and a receiver on the other side of the object to be tested P4. Observe the ultrasonic waves P5. Observe the sound energy, which has travelled from the transmitter to the receiver P6. Note down the signals with ordinary ultrasonic equipment
CU-4. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage



Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1** Introduction to Strength test for Steel bridge
- K2** Operations of Strength tests.
- K3** Types of Steel bridges and their properties.
- K4** Different materials of bridges
- K5** Measuring tools and techniques
- K6** Elements of steel bridges
- K7** Specifications as per requirements
- K8** Define ultrasonic testing
- K9** Define radiographic testing
- K10** Define Radiographs
- K11** Define hertz
- K12** Define ultra sound waves

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment.
- Adjust the sample in testing machine.
- Adjust for standard
- Maintain the tools
- Serviceability of equipment

TOOLS AND EQUIPMENT

- 1 Identifying tube
- 2 Radiograph
- 3 Receiver
- 4 Ultrasonic Equipment
- 5 Measurement tape
- 6 Gauge
- 7 File set



11.23.9 Perform Dye Penetrant Inspection or Liquid Penetrant Inspection (LPI) on Steel Bridges

Overview: This competency standard covers the skills and knowledge required to perform Strength test for steel bridges.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform Dye Penetrant Inspection OR Liquid Penetrant Inspection (LPI)	P1. Select observatory points P2. Prepare surface for the inspection (free from oil, grease, water or other contaminants) P3. Apply penetrant to the surface by spraying, brushing or immersing the parts in penetrant bath. P4. Dwell the penetrant P5. Apply developer to the surface by dusting, dipping or spraying. P6. Inspect surface under appropriate lighting P7. Clean the surface to remove developer
CU-3. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:



- K1** Introduction to Strength test for Steel bridge
- K2** Operations of Strength tests.
- K3** Types of Steel bridges and their properties.
- K4** Different materials of bridges
- K5** Measuring tools and techniques
- K6** Elements of steel bridges
- K7** Specifications as per requirements
- K8** Define Liquid Penetrant Inspection (LPI)
- K9** Define porosity
- K10** Define laps seams

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment.
- Adjust the sample in testing machine.
- Adjust for standard
- Maintain the tools
- Serviceability of equipment

TOOLS AND EQUIPMENT

- 1 Identifying tube
- 2 Penetrant
- 3 Developer
- 5 Measurement tape
- 6 Gauge
- 7 File set



11.23.10 Perform Magnetic Particle Inspection on Steel Bridges

Overview: This competency standard covers the skills and knowledge required to perform Strength test for steel bridges.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform Magnetic Particle Inspection (MPI)	P1. Select observatory points P2. Clean the surface before inspection P3. Apply the magnetizing force using permanent magnets, a electromagnetic yoke, prods, a coil or other means to establish the necessary magnetic flux P4. Dust on the light layer of magnetic particles with the magnetizing force still applied, remove the excess powder from the surface with few gentle puffs of dry air. (dry or wet magnetic suspension) P5. Inspect area carefully for finding out cluster of particles.
CU-3. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:



- K1** Introduction to Strength test for Steel bridge
- K2** Operations of Strength tests.
- K3** Types of Steel bridges and their properties.
- K4** Different materials of bridges
- K5** Measuring tools and techniques
- K6** Elements of steel bridges
- K7** Specifications as per requirements
- K8** Define magnetic flux
- K9** Define magnetic particles
- K10** Enlist types of magnetic suspensions

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment.
- Adjust the sample in testing machine.
- Adjust for standard
- Maintain the tools
- Serviceability of equipment

TOOLS AND EQUIPMENT

- 1 Identifying tube
- 2 Magnetic particles
- 5 Measurement tape
- 6 Gauge
- 7 File set
- 8 Prods
- 9 Portable coils and conductive cables
- 10 Electromagnets



11.23.11 Perform Eddy Current Testing on Steel Bridges

Overview: This competency standard covers the skills and knowledge required to perform Strength test for steel bridges.

Competency Units	Performance Criteria
CU1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU2. Perform Eddy Current Testing	P1. Select observatory points P2. Connect the probe with the system P3. Select probe from Low. Mid and High P4. Press the MAIN key to proceed with test setup. P5. Adjust the frequency as required. P6. Adjust the phase angle as required P7. Adjust the horizontal gain and vertical gain as required P8. Place the probe on the specimen to be tested away from cracks P9. Slide the probe on the specimen smoothly P10. Store data as frozen, captured or waterfall data P11. Scan the probe over part of the surface in a pattern that will provide complete coverage of the area being inspected P12. Care must be taken to maintain the same probe to surface orientation as probe wobble can affect interpretation of the signal.
CU3. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures



	P5. Clean the equipment P6. Check serviceability of equipment before storage
--	---

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1** Introduction to Strength test for Steel bridge
- K2** Operations of Strength tests.
- K3** Types of Steel bridges and their properties.
- K4** Different materials of bridges
- K5** Measuring tools and techniques
- K6** Elements of steel bridges
- K7** Specifications as per requirements
- K8** Define eddy current
- K9** Define NDT
- K10** Define coil
- K11** Define conductivity

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Balance the specimen in equipment.
- Adjust the sample in testing machine.
- Adjust for standard
- Maintain the tools
- Serviceability of equipment

TOOLS AND EQUIPMENT

- 1 Identifying tube
- 2 Magnetic particles
- 5 Measurement tape
- 6 Gauge
- 7 File set
- 8 Printer
- 9 Probe
- 10 Electromagnets
- 11 Voltmeter
- 12 Eddy current testing equipment



11.23.12 Perform Visual Inspection on Steel Bridges

Overview: This competency standard covers the skills and knowledge required to perform Strength test for steel bridges.

Competency Units	Performance Criteria
CU-1. Carry out initial preparatory activities.	P1. Access relevant job instructions from laboratory information management system (LIMS) P2. Interpret test request to confirm samples to be tested, the test method and equipment involved P3. Identify hazards to take sample P4. Prepare and workplace for task P5. Assemble / collect all required equipment and materials P6. Plan task / work sequences for optimum efficiency
CU-2. Perform visual inspection on steel bridges	P1. Identify any document alignment discontinuities. P2. Identify the foundation arrangement, scour susceptibility, structure sensitivity to scour and the 'safe' scour level. P3. Check member and structure alignment for discontinuities P4. Check for scour at supports P5. Identify maintenance requirements P6. Verify 'Structural Inventory' data held in the Bridge Information System (BIS)
CU-3. Maintain a safe work environment	P1. Use PPEs and apply safe work practices P2. Rehabilitate sampling site and Minimize generation of wastes P3. Collect waste material P4. Dispose waste Material in accordance with environmental/ quarantine requirements and workplace procedures P5. Clean the equipment P6. Check serviceability of equipment before storage

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1** Define visual inspection
- K2** Respond to the test request



- K3** Describe hazards in taking samples/ visual inspection.
- K4** Describe instruments for visual inspection
- K5** Describe briefly Corrosion, Fatigue (low cycle and high cycle)
- K6** Describe Cracks in elements and joints and Deficiencies in connections
- K7** Permanent Deformation (i.e. buckling, bending, etc.)
- K8** Alignment discontinuity and scouring
- K9** Coating film diagnosis
- K10** Explain use and types of borescope (boroscope)
- K11**

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Maintain the tools
- Serviceability of bridge

TOOLS AND EQUIPMENT

Identifying tube

Note book

Measurement tape

Boroscope

Videoscope

Pipe camera system

1. Safety Vest
2. Safety Shoes
3. Shirt with long sleeves and Pants
4. Hard Hat with chinstrap
5. Gloves
6. Hand Mirror for viewing behind bearings, etc.
7. Flashlight
8. Geologist's Hammer
9. Measuring Tape
10. Crayon, Keel, Felt-tip Marker and/or Chalk for marking
11. Digital Camera with zoom and date feature
12. Inspection Forms
13. Sketch Drawing Forms
14. Copy of previous report
15. First-Aid Kit
16. 4-Gas Meter
17. Shovel and Broom
18. Wire Brush
19. Crack Comparator Gauge
20. Extension Ladder
21. Boat or Barge
22. Under Bridge Inspection Vehicle (UBIV) – 50' and 60' reach
23. Rope Access Inspector's Kit – suspension harness with equipment
24. Climbing Helmet with Headlamp
25. Climbing Gloves



11.24. Entrepreneurial Skills

11.24.1 Investigate micro business opportunities

Overview: This competency describes the performance outcomes, skills and knowledge required to develop business ideas, and to investigate market needs and factors affecting potential markets.

Competency Unit	Performance Criteria
CU-1. Describe business ideas	P1. Gather information for business ideas from appropriate sources P2. List details of business ideas and opportunities P3. Research alternative business ideas in light of the resources available P4. Specify and list products and services to match business ideas P5. Identify and research potential customer information for business ideas P6. Identify and take into account financial, business and technical skills available when researching business opportunities
CU-2. Identify market needs	P1. Collect information regarding market size and potential from appropriate sources P2. Investigate market trends and developments to identify market needs relative to business ideas P3. Gather market information from primary and secondary sources to identify possible market needs in relation to business ideas P4. Identify ethical and cultural requirements of the market and their impact on business ideas P5. Identify new and emerging markets and document their features P6. Identify and organise information on expected market growth or decline and associated risk factors
CU-3. Investigate factors affecting the market	P1. Identify projected changes in population, economic activity and the labour force that may affect business ideas P2. Identify movements in prices and projected changes in availability of resources P3. Review trends and developments and identify their potential impact on business ideas



Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Define entrepreneurship.
- K2.** Explain the concept of entrepreneurship
- K3.** Explain the various types of enterprise that exist in the community
- K4.** Identify and interpret the terms and elements involved in the concept of enterprise
- K5.** Appreciate that the advancement of individual and society in general when entrepreneurship is adopted
- K6.** Explain various motivational factors that entrepreneurs possess and utilize.
- K7.** Exhibit the skills needed to assess and evaluate a risk
- K8.** Describe the outline of small enterprise
- K9.** Describe the creativity and innovation
- K10.** Apply the techniques for developing creative abilities
- K11.** Explain the resources of business idea
- K12.** Explain the collective and creative thinking
- K13.** Explain how to generate a business idea
- K14.** Appreciate the importance of, and possess techniques for identifying and assessing business opportunities.
- K15.** Identify the various entrepreneurial characteristics
- K16.** Access personal potential for becoming future entrepreneurs.
- K17.** Identify leadership qualities which are essential to the success of entrepreneurs
- K18.** Identify self- management skills and how they are important to be enterprising
- K19.** Apply a rational approach to make personal and business decisions
- K20.** Explain the steps for decision making and rating of decision making skills
- K21.** Apply the rules of negotiation for resolving business issues

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Evidence of the following is essential:

- Thorough investigation of business opportunities and ideas



- Clearly identified products/services and customer information for each business idea
- Thorough collection and analysis of market information and associated factors relating to business ideas
- Knowledge of ethical and cultural requirements.

Instruments & Consumables

S No.	Description (Instruments)
1	Calculator
2	Ruler
3	Papers and Pencil



11.24.2 Develop a micro business proposal

Overview: This competency describes the performance outcomes, skills and knowledge required to develop an identified business idea, to research the feasibility of the business opportunity and to present a business idea in formats that suit a range of stakeholders

Competency Unit	Performance Criteria
CU1. Evaluate business opportunities	P1. Identify and research key factors that influence viability of business ideas P2. Analyze business ideas in terms of personal or family needs and commitments P3. Evaluate impacts of emerging or changing technology, including e-commerce, on the business P4. Determine viability of business opportunity in line with perceived risks, resources available, financial returns and other outcomes sought P5. Assess and match personal skills/attributes against those perceived as necessary for a particular business opportunity P6. Identify and assess business risks according to resources available and personal preferences
CU2. Detail the business idea	P1. Develop an accurate description of the business idea for key stakeholders P2. Develop an accurate summary of the major products and/or services required to suit personal needs and requirements
CU3. Prepare the business overview to suit different stakeholders	P1. Present an accurate list of key stakeholders and their information requirements P2. Determine an acceptable method of presentation of information for each stakeholder P3. Provide accurate customized information to target audiences

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:



- K1.** State and local government legislative requirements relating to business operation, especially in regard to occupational health and safety (OHS) and environmental issues,
- K2.** Income and expenditure costing
- K3.** Principles of risk assessment relevant to the business opportunity
- K4.** Business proposal formats or methods of presentation.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

Evidence of the following is essential:

- accurate and complete outline of the business idea that considers the major elements of:
 - products/services
 - customers
 - operations and processes
 - income and expenditure
 - resources
 - marketing
 - location

Instruments & Consumables

S No.	Description (Instruments)
1	Calculator
2	Ruler
3	Papers and Pencil



11.24.3 Develop a marketing plan

Overview: This competency describes the performance outcomes, skills and knowledge required to research, develop and present a marketing plan for an entrepreneurship business

Competency Unit	Performance Criteria
CU-1. Devise marketing strategies	P1. Evaluate marketing opportunity options that address organizational objectives, and evaluate their risks and returns in the selection process P2. Develop marketing strategies that address strengths and opportunities within the organization's projected capabilities and resources P3. Develop strategies which increase resources or organizational expertise where gaps exist between current capability and marketing objectives P4. Develop feasible marketing strategies and communicate reasons that justifies their selection P5. Ensure strategies align with organization's strategic direction P6. Develop a marketing performance review strategy, incorporating appropriate marketing metrics to review of organizational performance against marketing objectives
CU-2. Plan marketing tactics	P1. Detail tactics to implement each marketing strategy in terms of scheduling, costing, accountabilities and persons responsible P2. Identify coordination and monitoring mechanisms for scheduled activities P3. Ensure tactics are achievable within organization's projected capabilities and budget P4. Ensure tactics meeting legal and ethical requirements P5. Ensure tactics provide for ongoing review of performance against objectives and budgets, and allow marketing targets to be adjusted if necessary



CU-3. Prepare and present a marketing plan	P1. Ensure marketing plan meets organizational, as well as marketing, objectives and incorporates marketing approaches and a strategic marketing mix P2. Ensure marketing plan contains a rationale for objectives and information that supports the choice of strategies and tactics P3. Present marketing plan for approval in the required format and timeframe P4. Adjust marketing plan in response to feedback from key stakeholders and disseminate for implementation within the required timeframe
---	--

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of: Culturally appropriate communication skills to relate to people from diverse backgrounds and people with diverse abilities

K1. Describe the market & marketing

K2 Differentiate between sellers and buyers' market

K3. Describe the five 'w' of market

K4. Explain the procedure for assessing the market size and demand

K5. Explain the major factors to be considered when selecting a location for a business

K6. Describe the basic types of business ownership and the limitation of each

K7. Explain the computation of initial and working capital needed to start an enterprise

K8. Identify the advantages and disadvantages of using various sources of capital to start an enterprise

K9. Explain the component of cost of product

K10. Explain the breakeven analysis for a new business

K11. Calculate the breakeven point for various new business

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Devising, documenting and presenting a marketing plan
- Detailing approaches
- The marketing mix to achieve organizational marketing objectives.

Instruments & Consumables

1 Calculator, 2 Ruler, 3 Papers and Pencil



11.24.4 Develop and review a business plan.

Overview: This competency standard covers the process of developing and reviewing business for a small business enterprise. It requires the application of knowledge and skills to determine the scope of the business plan, prepare a business plan, determine goals, trial systems, and document, monitor and review the business plan.

Competency Unit	Performance Criteria
CU-1. Determine scope of business	P1. Determine scope of the business plan and associated systems is determined in consultation with specialist personnel. P2. Access accurate information for inform business plan development P3. Account for and incorporate trends and seasonal variations into the business plan. P4. Account for strategic goals, targets and directions of the enterprise in the development of the business plan P5. Comply Legal obligations in developing the business plan.
CU-2. Prepare business plan	P1. Develop operational goals and targets to meet the enterprise strategic plan. P2. Identify and incorporate supply chains into the business plan. P3. Identify risk management needs are within the business plan. P4. Incorporate trial systems in order to test budgetary impact and operational potential prior to full implementation of the business plan. P5. Set clear and measurable indicators of operational performance to allow for realistic analysis of performance.
CU-3. Document and review business plan	P1. Include fiscal and operational systems that enhance performance management and suit enterprise requirements. P2. Incorporate resource considerations the business plan. P3. Document accurately and clearly communicate business Plan to all relevant parties. P4. Monitor to identify strengths, weaknesses and areas for improvement performance against the business plan



	P5. Make recommendations to improve the business plan and associated systems as required.
--	--

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Appreciate the importance of business plan
- K2.** Explain the process of writing a business plan
- K3.** Develop feasibility for a business idea
- K4.** Realize the problem that may be encountered when starting a small business/Enterprise
- K5.** Develop a business plan for a small business on the standard format
- K6.** Evaluate the business plan in a real market saturation
- K7.** working knowledge of environmental, OHS, industrial relations, taxation, corporate and industry legislation as they relate to the enterprise

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- Competence in develop and review a business plan requires evidence that demonstrates ability to scope the business plan and determine key objectives and targets. It also requires competence in specifying key performance targets, assessing the relevance of the business plan, and trial systems. The business plan also needs to be documented and reviewed.
- The skills and knowledge required to develop and review a business plan must be **transferable** to a different work environment. For example, if competence is demonstrated in developing a business plan for a small enterprise, it must also be evident in reviewing a business plan in medium or large enterprise environment.

Instruments & Consumables

S No.	Description (Instruments)
1	Construction Lab Tools
2	Rule, tape, square, hammer, hand saw, hand plane, chisel, shovel, wheelbarrow, sledge hammer, pick, mattock and crow bar and pinch bar for given tasks.



11.24.5 Organize finances for the micro business

Overview: This competency standard describes the performance outcomes, skills and knowledge required to investigate the financial capacity to enter into a micro business, to determine the projected cash flow, to source finances and to monitor the profitability of the business.

Competency Unit	Performance Criteria
CU-1. Ascertain own financial position and the ability to provide capital/equity for the business	P1. Realistically detail personal, family or community financial situation in terms of funds available and commitments already incurred P2. Determine equity finance and assets available for micro business from personal, family or community sources
CU-2. Determine projected cash flow for the business	P1. Determine the level of forecast business activity over a year and the business mix P2. Estimate establishment costs for the business and repayment schedule for borrowings P3. Calculate the monthly variable and fixed costs needed to conduct business activity over a year P4. Estimate personal drawings needed to be taken from the business P5. Estimate the monthly income generated by the business for a year based on price per unit item or hourly charge rate for labor P6. Develop a cash flow budget for the first year of business operation P7. Seek professional advice to estimate goods and services tax and operating finance required for the business
CU-3. Source the required funds to establish the business	P1. Estimate required funding to establish and run the business based on expected sales and activity levels, available finances and commitments P2. Investigate methods of accessing alternative sources of finance P3. Identify strategies for meeting financial obligations P4. Implement plans to access available funds as required
CU-4. Monitor profitability of the business	P1. Maintain and review monthly expenditure and income records P2. Compare equity at beginning and end of a year to estimate



	business performance P3. Assess the financial viability of the business after a year of operation P4. Seek professional advice on depreciation, insurance and tax implications of the business
--	---

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Basic budgeting
- K2.** basic costing for the business
- K3.** financial commitments and requirements
- K4.** financial reports and terminology
- K5.** methods and relative costs of obtaining finance
- K6.** own financial position
- K7.** Sources of advice and assistance.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

Evidence of the following is essential:

- investigation of own financial position and needs
- investigation of projected cash flow for the business
- estimation of the funding needed to establish and operate the business
- assessment of the financial viability of the business
- Knowledge of basic budgeting.



11.24.6 Manage human resources

Overview: This competency standard covers the skills and knowledge required to manage human resources and to manage and develop human resources to achieve organization's operational objectives

Competency Unit	Performance Criteria
CU-1. Lead and motivate people	P1. Establish goals for people and teams to optimize achievement in work tasks. P2. Take into account the capabilities of people and teams. P3. Provide advice and support sensitive to the individual's needs to people in the performance of their duties. P4. Undertake activities to achieve commitment to common goals. P5. Recognize and encourage initiative and innovation P6. Recognize and communicate achievements within the organization.
CU-2. Undertake human resource planning	P1. Determine human resource needs within the anticipated operational needs and allocated budget. P2. Analyze alternatives to staffing levels which clearly demonstrate returns to the organization. P3. Develop contingency plans for staffing which meet key provisions of the human resources plan. P4. Compare existing competencies of staff with the needs of the work group. P5. Plan staffing levels and negotiate with stakeholders within the organisational framework to achieve maximum efficiency of operations.
CU-3. Develop and facilitate performance	P1. Negotiate performance criteria individuals, teams and work groups. P2. Review performance criteria as circumstances change. P3. Conduct performance appraisal based on clearly established and agreed performance criteria. P4. Identify and propose the total performance development system strategies to rectify performance shortfalls and recognize success.



	P5. Address performance problems confidentially and in a constructive and timely manner, in line with relevant organizational procedures. P6. Make selections, transfers and promotions in accordance with organization policies and supported with documented information. P7. Develop and implement mechanisms for the identification of human resource development needs within the work group taking account of the strategic plan for the organisation.
CU-4. Facilitate training, education and development opportunities	P1. Make information on planned training events widely available throughout the organization. P2. Include training, education and development plans as part of individual/team performance plans. P3. Facilitate individual/team access to, and participation in, training, education and development opportunities. P4. Contribute coaching and mentoring effectively to the training, education and development of personnel in an environment of change. P5. Enhance training, education and development opportunities of individual, team and organizational performance. P6. Create workplace environment in which facilitates training, education and development

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Describe the hiring method/Procedures
- K2.** Describe the term & conditions of services and job description for various employments
- K3.** Describe the characteristics of successful sales personals



- K4. Communication principles
- K5. Conflict resolution principles and practice
- K6. Equal Employment Opportunity
- K7. Grievance procedures
- K8. Interpersonal relations
- K9. Leadership theory and principles
- K10. Management principles and practice
- K11. Occupational Health and Safety
- K12. Training and education principles
- K13. Training need analysis

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- It is essential that competence be demonstrated in the application of human resource management in a wide range of contexts in achieving the organisation's objectives.
- Evidence should be gathered over a period of time in a range of actual or simulated workplace environments.
- Evidence of competent performance should be obtained by observing an individual in a management role within the workplace or exercise or operational environment. Knowledge may be assessed through written assignments, project reports, debriefings and action learning projects.



11.24.7 Market products and services

Overview: This competency standard covers the skills and knowledge required to analyze market information, Identify and evaluate factors to include in a marketing plan, Develop a marketing plan for your products and services, Determine promotional strategies, Implement marketing activities and Evaluate marketing performance.

Competency Unit	Performance Criteria
CU1. Analyze market information	P1. Identify, research and analyze existing or new markets for existing or new products or services using techniques to ensure reliable data P2. Analyze past trends and developments to determine market variability and associated risks P3. Develop gross margin budgets to account for market variability P4. Identify and evaluate competing products to determine strengths and weaknesses of own products P5. Monitor market environment to ensure information is current and reliable P6. Identify the legal, ethical and environmental constraints of the markets and their effect on the enterprise P7. Identify product specifications that suit market requirements and price advantage at the time P8. Present clear and concise information to the enterprise management team.
CU2. Identify and evaluate factors to include in a marketing plan	P1. Identify and evaluate production processes to ensure required product specifications are met P2. Identify and assess alternative selling strategies and techniques to identify marketing targets and methods P3. Identify and assess distribution channels and their role in your marketing strategies P4. Ensure the data used is reliable and the market environment and trends are substantiated P5. Evaluate the role of marketing professionals in providing advice
CU3. Develop a	P1. Establish marketing objectives based on current and potential



marketing plan for your products and services	product specifications P2. Select appropriate production processes to ensure product specifications are met P3. Select selling strategies to ensure required prices are achieved P4. Select appropriate distribution channel options to ensure access to target markets is achieved efficiently and appropriately P5. Establish time-frames for production, distribution and selling activities P6. Develop a gross margin budget to demonstrate the cost effectiveness of the marketing plan P7. Develop partial gross margin budgets to account for market variability
CU4. Determine promotional strategies	P1. Prepare and record detailed plans for promotional activities P2. Outline objectives, level of exposure and available markets P3. Ensure strategies take account of time management and scheduling issues, and resource constraints P4. Create promotional materials that enhance the product and commercial presentation P5. Record and communicate priorities, responsibilities, timelines and budgets for promotional activities.
CU5. Implement marketing activities	P1. Schedule planned marketing activities within appropriate timeframes P2. Develop measurable performance targets that meet business plan objectives P3. Organize distribution channels and ensure product and service information is accurate and readily available to clients P4. Implement marketing activities within budgetary constraints to meet legal, ethical and enterprise requirements
CU6. Evaluate marketing performance.	P1. Review the established marketing objectives to ensure they remain viable P2. Make an objective assessment of the marketing plan and its implementation by a comparison of valid and reliable data against the established objectives P3. Assess product, pricing and distribution policies in relation to market changes, marketing objectives and enterprise



	requirements P4. Identify areas of positive marketing performance and take corrective action to remedy poor marketing performance areas P5. Document and distribute information for continual analysis and effective planning management
--	--

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Describe the life cycle of product
- K2.** Identify the various ways of selecting suppliers,
- K3.** Explain the inventory management of stock, raw material and finished goods etc.
- K4.** Appreciate the importance of financial record keeping in a small business
- K5.** Explain techniques to keep cost as low as possible
- K6.** Develop balance sheet for a small enterprise
- K7.** Explain the operating cycle concept
- K8.** Explain the income tax computation procedure for a small business
- K9.** Explain the basic scheme of sales tax
- K10.** Explain the assessment procedure for returns and filling of returns.

Critical Evidence(s) Required

The evidence required to demonstrate competency in this unit must be relevant to workplace operations and satisfy holistically all of the requirements of the performance criteria and required skills and knowledge and include achievement of the following:

- identify the marketable features of the product and potential markets
- develop a range of marketing alternatives
- collect and analyses data to assess alternatives in a marketing plan
- evaluate performance targets and recommend modifications or improvements
- implement and evaluate a marketing plan
- Plan to manage promotional activities.



11.24.8 Monitor and review business performance

Overview: This competency standard covers the skills and knowledge required to evaluate commercial performance, Allocate and co-ordinate business resources, Identify performance requirements and Review business performance

Competency Unit	Performance Criteria
CU-1. Evaluate commercial performance	P1. Gather and analyze data relating to enterprise performance to identify historical and current performance. P2. Review and analyze operational structures to determine the suitability of organizational processes to enterprise objectives. P3. Evaluate enterprise strengths and weaknesses against market conditions to determine current and future capacities. P4. Evaluate enterprise objectives are to identify variations and scope for future development.
CU-2. Allocate and co-ordinate business resources	P1. Identify and communicate roles and responsibilities of personnel. P2. Identify resource requirements for enterprise and cost them using standard financial analysis techniques. P3. Calculate costs of ensuring sustainability of enterprise operations and factor into business planning for the enterprise.
CU-3. Identify performance requirements	P1. Develop realistic performance indicators within available timeframes and resources P2. Identify and minimize factors inhibiting performance against objectives. P3. Monitor and assess market conditions based on relevant data. P4. Prepare and incorporate strategies and programs to promote the sustainability of operations into enterprise procedures.
CU-4. Review business performance	P1. Review regularly enterprise operations to identify opportunities for improvements in performance. P2. Monitor and anticipate impact of natural conditions on enterprise to assess sustainability of resource use. P3. Compare costs and estimates with resource allocation. P4. Determine operational plans to determine schedule of activities

Knowledge and understanding



The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K1.** Rates of return for products and/or services
- K2.** Financial analysis techniques
- K3.** Structure and operation of small businesses relevant State/Territory Occupational Health and Safety (OHS)
- K4.** Legislative requirements
- K5.** Environmental conditions, positive environmental practices and negative impact minimization measures
- K6.** Human resource requirements for the enterprise
- K7.** Transport requirements for the enterprise
- K8.** Enterprise/property improvement requirements.
- K9.** Market performance in commodities
- K10.** Statutory marketing requirements

Critical Evidence(s) Required

The evidence required to demonstrate competency in this unit must be relevant to workplace operations and satisfy holistically all of the requirements of the performance criteria and required skills and knowledge and include achievement of the following:

- gather and analyze data relating to enterprise performance
- review operational structures to determine effectiveness
- identify available resources to assess capacity
- develop realistic performance indicators
- review enterprise operations against performance indicators
- Plan to improve business performance by addressing results of review.



11.24.9 Negotiate for resolving business issues

Overview: This competency standard covers the skills and knowledge required to Develop and implement issue resolution and grievance procedures and Manage disciplinary matters

Competency Unit	Performance Criteria
CU-1. Develop and implement issue resolution and grievance procedures	P1. Establish problem solving/issue resolution procedures within legislative requirements and organization's guidelines. P2. Manage grievances and complaints in a timely and caring way to optimize likelihood of a favorable outcome for all parties and in line with organizational objectives and procedures. P3. Document and communicate individual's rights and obligations under industrial awards/agreements and legislation in a clear and concise manner and in appropriate language. P4. Conduct hearings, interviews and meetings within the principles of industrial democracy and participative, consultative processes. P5. Identify and invite all relevant industrial parties to participate in the resolution process.
CU-2. Manage disciplinary matters	P1. Implement disciplinary matters in accordance with organization's procedures. P2. Conduct investigations in a caring and confidential manner to maintain performance and morale. P3. Provide feedback promptly. P4. Institute appeals processes in accordance with organizational procedures. P5. Recognize and recommend deficiencies in procedures for changes made

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of:

Define negotiation

Importance of negotiation in business

Ways to prepare for negotiation



- K1. State the Techniques for conducting negotiation
- K2. Describe the Benefits of negotiated agreements
- K3. Describe the Relationship of values with negotiation
- K4. Negotiate with people from other cultures
- K5. Describe the behavior of people in conflict situations,
- K6. Describe the incident management techniques using negotiation
- K7. Describe the indicators of neglect and abuse particularly in young people
- K8. Explain the instructions and procedures for responding to security risk situations
- K9. Describe the legal provisions relating to duty of care of self and others
- K10. State the limits of own responsibility and authority
- K11. Describe the observation and monitoring techniques
- K12. Explain the operational functions and procedures for the use of communications, security and personal protection equipment
- K13. Describe the principles of effective communication including techniques
- K14. State the procedures and requirements for documenting security incidents
- K15. Describe the reporting structure and processes

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- With a partner, write a dialog between two parties negotiating for a large purchase to be delivered by the end of the month. Specify other details of the negotiation to make it more realistic. One partner should repeatedly act uncooperative or confrontational, while the other tries to keep the process moving forward. Perform your dialog for the class.
- Write a dialog between two parties negotiating Implement disciplinary matters in accordance with organization's procedures to investigations in a caring and confidential manners.

Instruments & Consumables

- 1- Pencil 2- rubber 3- ruler